Lower Joseph Creek Restoration Project

Vegetation/Disturbance, Air Quality & Climate Report

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for:
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Regulatory Requirements

Multiple-Use Sustained Yield Act of 1960. Requires that national forest lands shall be administered for a variety of multiple uses, and that all resources shall be maintained as renewable in perpetuity for regular periodic output of several products and services at a sustainable level.

National Environmental Policy Act of 1969 (NEPA). Established procedures for decision making, disclosure of effects, and public involvement on all major federal actions.

National Forest Management Act of 1976 (NFMA). The Wallowa Whitman forest plan was developed in accordance with NFMA, as expressed by the 1982 planning rule.

While federal laws like the National Forest Management Act establish the regulatory requirements of forest management for federal agencies, the detailed direction that affects the project-level vegetation analysis being undertaken in this proposed action are contained in the forest plan for the Wallowa Whitman National Forest (USDA 1990, as updated 2004) and the Hells Canyon National Recreation Area Comprehensive Management Plan. These include the Forest-wide goals and standards and guidelines and Management Area direction that have relevance to the proposed action.

Clean Air Act. Implementation of any prescribed fire is required to comply with the Clean Air Act by following rules established by the state of Oregon.

Forest-wide standards and guidelines

Diversity (FP 4-30) –

- Retain, through precommercial and commercial thinning, a diversity of tree species based on site potential.
- Allow for all natural species to function following vegetation manipulation.

Timber Management (FP 4-48) –

Select silvicultural systems which will, to the extent possible and within the intent of the land management objectives:

- Permit the production of a volume of marketable trees sufficient to utilize all trees that meet utilization standards and are designated for harvest.
- Permit the use of an available and acceptable logging method that can remove logs and other products without excessive damage to the identified desirable residual vegetation.
- Be capable of providing special conditions, such as a continuous canopy or continuous high density live root mats, when required by critical soil conditions or as needed to achieve particular management objectives, such as streamside protection, wildlife needs, and visual enhancement.
- Permit control of vegetation to establish desired numbers and rates of growth of trees, as well as vegetation needed to achieve other management objectives identified in site-specific silvicultural prescriptions.
- Promote a stand structure and species composition that minimizes serious risk of damage caused by mammals, insects, disease, or wildfire, and will allow treatment of existing insect, disease, or fuel conditions.
- Be capable of achieving management objectives such as those for streamside protection, wildlife needs, and visual resources.
- Include consideration of fuel treatment commensurate with resource needs.
- Be the most economical system to meet the desired objectives.

Reforestation. Selection of reforestation methods will be made on a site-by-site basis during project-level analysis. This analysis will always consider the option of natural regeneration. Design harvest and regeneration practices so that there is reasonable assurance of adequate restocking within five years after final harvest.

Miscellaneous (FP 4-56) –

Tree Encroachment. Recognize natural grasslands and meadows primarily for the forage value and habitat they provide. Encroachment of trees on meadows and other high forage producing nontimbered sites may be prevented if such action is warranted based on site specific analysis including consideration of other resource objectives.

Management direction specific to individual management areas

The project area includes 9 Management Areas (MA) as described in the Wallow Whitman NF forest plan (starting pg. 4-56). Timber Production Emphasis (MA-1) makes up approximately 28,100 acres of the project area. Wildlife/Timber (MA 3) includes another 35,400 acres. Outside the HCNRA, Wild and Scenic Rivers (MA 7), Research Natural Areas (MA 12) and Old Growth Preservation (MA 15) comprise approximately 6,060 acres. The remaining 3 management areas within the project areas (approximately 28,000 acres) are within the HCNRA and consist of HCNRA Dispersed Recreation/Native Vegetation (MA 9), HCNRA Forage Production (MA 10) and HCNRA Dispersed Recreation/Timber Management (MA 11).

MA 1 – Timber Production Emphasis.

Timber. Use timber management to convert unmanaged natural stands to vigorous managed stands.

Insects and Diseases. Prevent and/or suppress insects and diseases using integrated pest management techniques when outbreaks threaten resource management objectives. Activities might include stump treatment for root rots, application of pesticides for defoliators and cone insects, early harvest, stocking control, and species control. The most cost-effective strategy may be no action, which will be considered in project analyses.

MA 3 – Wildlife/Timber.

Timber. Timber management will be similar to that of Management Area 1 but constrained to meet wildlife objectives. Where it is determined through project-level environmental analysis that use of uneven-aged management methods are practical, and better meet the objectives of Management Area 3, these methods may be used.

Insects and Diseases. Apply standards and guidelines from Management Area 1.

MA 9 – HCNRA Dispersed Recreation/Native Vegetation.

Vegetative Practices (CMP ROD p46). Prescribed fire will be allowed to maintain, restore, and sustain healthy forests and grasslands.

MA 10 - HCNRA Forage Production.

Vegetative Practices (CMP ROD p46).

Provide for the use of forested vegetation treatments through silvicultural methods and prescribed fire to replicate naturally-occurring processes which have shaped the character of the landscape. Silvicultural treatments will be restricted to uneven-age management, prescribed fire, wildland fire use, precommercial thinning, commercial thinning, salvage and sanitation harvesting.

MA 11 - HCNRA Dispersed Recreation/Timber Management.

Vegetative Practices (CMP ROD p46). Provide for the use of forested vegetation treatments through silvicultural methods and prescribed fire to replicate naturally-occurring processes which have shaped the character of the landscape. Silvicultural treatments will be restricted to uneven-age management, prescribed fire, wildland fire use, precommercial thinning, commercial thinning, salvage and sanitation harvesting.

MA 15 – Old Growth Preservation.

Timber. Areas allocated to old-growth timber will have no scheduled timber harvest although salvage may occur following catastrophic destruction if a more suitable replacement stand exists.

Insects and Diseases. Control of pests is encouraged where pests threaten destruction of an old-growth stand. Where destruction of the old-growth is not likely, artificial control of pests will occur only when this can be accomplished without adverse effects on old-growth values.

Eastside screens

In August 1993 the Regional Forester issued a letter providing direction to eastside National Forests on retaining old-growth attributes at the local scale and moving toward the historic range of variability (HRV) across the landscape. These became known as the “eastside screens.” A subsequent decision notice in May 1994 amended all eastside Forest plans (including the Wallowa Whitman) to include these standards.

The interim wildlife standard has two possible scenarios to follow based on the Historical Range of Variability (HRV) for each biophysical environment within a given watershed. For the purposes of this standard, late and old structural stages (LOS) can be either "Multi-strata with Large Trees" (MSLT), or "Single Strata with Large Trees" (SSLT), as described in Table 1 of the Ecosystem Standard. These LOS stages can occur separately or in some cases, both may occur within a given biophysical environment. LOS stages are calculated separately in the interim ecosystem standard. Use Scenario A whenever anyone type of LOS is below HRV. If both types occur within a single biophysical environment and one is above HRV and one below, use Scenario A. Only use Scenario B when both LOS stages within a particular biophysical environment are at or above HRV.

Scenario A - If either one or both of the late and old structural (LOS) stages falls BELOW HRV in a particular biophysical environment within a watershed, then there should be NO NET LOSS OF LOS from that biophysical environment. DO NOT allow timber sale harvest activities to occur within LOS stages that are BELOW HRV.

1) Some timber sale activities can occur within LOS stages that are within or above HRV in a manner to maintain or enhance LOS within that biophysical environment. It is allowable to manipulate one type of LOS to move stands into the LOS stage that is deficit if this meets historical conditions.

2a) Maintain all remnant late and old seral and/or structural live trees >= 21" DBH that currently exist within stands proposed for harvest activities.

2b) Manipulate vegetative structure that does not meet late and old structural (LOS) conditions, (as described in Table 1 of the Ecosystem Standard), in a manner that moves it towards these conditions as appropriate to meet HRV.

2c) Maintain open, parklike stand conditions where this condition occurred historically. Manipulate vegetation in a manner to encourage the development and maintenance of large diameter, open canopy structure. (While understory removal is allowed, some amount of seedlings, saplings, and poles need to be maintained for the development of future stands).

3) Maintain connectivity and reduce fragmentation of LOS stands by adhering to the following standards: INTENT STATEMENT: While data is still being collected, it is the best understanding of wildlife science, today, that wildlife species associated with late and old structural conditions, especially those sensitive to "edge,” rely on the connectivity of these habitats to allow free movement and interaction of adults and dispersal of young. Connectivity corridors do not necessarily meet the same description of

"suitable" habitat for breeding, but allow free movement between suitable breeding habitats. Until a full conservation assessment is completed that describes in more detail the movement patterns and needs of various species and communities of species in eastside ecosystems, it is important to insure that blocks of habitat maintain a high degree of connectivity between them, and that blocks of habitat do not become fragmented in the short-term.

4) Adhere to the following specific wildlife prescriptions. These standards are set at MINIMUM levels of consideration. Follow Forest Plan standards and guidelines when they EXCEED the following prescriptive levels: a) Snags, Green Tree Replacements and Down Logs:

INTENT STATEMENT - Most (if not all) wildlife species rely on moderate to high levels of snags and down logs for nesting, roosting, denning and feeding. Large down logs are a common and important component of most old and late structural forests. Past management practices have greatly reduced the number of large snags and down logs in managed stands.

(1) All sale activities (including intermediate and regeneration harvest in both even-age and uneven-age systems, and salvage) will maintain snags and green replacement trees of > 21 inches DBH, (or whatever is the representative DBH of the overstory layer if it is less than 21 inches), at 100% potential population levels of primary cavity excavators. This should be determined using the best available science on species requirements as applied through current snag models or other documented procedures. NOTE: for Scenario A, the live remnant trees (>=21" DBH) left can be considered for part of the green replacement tree requirement.

(2) Pre-activity (currently existing) down logs may be removed only when they exceed the quantities listed below. When pre-activity levels of down logs are below the quantities listed, do not remove downed logging debris that fits within the listed categories. It is not the intention of this direction to leave standing trees for future logs in addition to the required snag numbers, or to fall merchantable material to meet the down log requirements. The snag numbers are designed to meet future down log needs in combination with natural mortality. Exceptions to meeting the down log requirement can be made where fire protection needs for life and property cannot be accomplished with this quantity of debris left on site. The down log criteria are not intended to preclude the use of prescribed burning as an activity fuels modification treatment. Fire prescription parameters will ensure that consumption will not exceed 3 inches total (1 1/2 inch per side) of diameter reduction in the featured large logs (sizes below). Tools such as the CONSUME and FOFEM computer models, fire behavior nomograms, and local fire effects documentation can aid in diameter reduction estimates.

Leave logs in current lengths; do not cut them into pieces. Longer logs may count for multiple "pieces" without cutting them. Cutting them may destroy some habitat uses and also cause them to decay more rapidly. It is also not expected that the "pieces" left will be scattered equally across all acres.

Species	Pieces per Acre	Diameter Small End (inches)	Piece Length & Total Linear Length
Ponderosa pine	3-6	12	>6 feet; 20 – 40 feet
Mixed conifer	15-20	12	>6 feet; 100 -140 feet

Range of Variation Guidance for Forest Vegetation Project Planning

The Regional Forester Amendment #2 of June 12, 1995 established interim riparian, ecosystem, and wildlife standards for timber sales (these standards are referred to as the “Eastside Screens”). Items 5 and 6 of the Eastside Screens require that a range of variation approach be used when comparing historical reference and current conditions, incorporating the best available science

A letter from the Wallowa Whitman Forest Supervisor to the forest leadership team dated 7/27/2011 replaced previous guidance for RV analysis. The letter states that Range of Variation Recommendations for Dry, Moist and Cold Forests, by David Powell, May 2010, incorporates the best available science and that all future forest vegetation planning work should utilize the range of variation tables in Powell 2010.

Required monitoring

Areas proposed for harvest under selection cutting can be regenerated using standard reforestation techniques. The reforestation technique and range of desired stocking will be documented in a formal silvicultural prescription. These areas will be monitored by the implementation silviculturist to ensure the areas meet the prescribed post treatment stocking. If the areas do not meet desired stocking after 5 years, conditions that are inhibiting regeneration will be identified and remedial action may be prescribed to ensure regeneration.

Air quality is monitored by the states of Oregon, Washington, and Idaho in accordance with Federal Air Quality standards. Permits for prescribed fire (activity fuels or landscape) are issued on a daily basis from the respective states to ensure pollutants do not exceed ambient air quality standards. Prior to implementing prescribed fire the Forest Service is required to attain permits to ensure compliance with the Clean Air Act and state law.

Vegetation and disturbance regimes

Resource Indicators and Measures

The purpose and need for proposing an action was determined by comparing the objectives and desired conditions in the Wallowa Whitman NF Land Resource and Management Plan and the Hells Canyon National Recreation Area Comprehensive Management Plan to the existing conditions related to forest resiliency and forest function. Where plan information was dated or not explicit, local research and the best available science were utilized. Figure V/D_1 is a map showing the location of site specific science relevant to vegetation and disturbance for the Lower Joseph Project area. This is neither an extensive list nor exclusive of other relevant literature in similar ecological systems, but serves as an example of the depth of knowledge about this particular basin and project area.

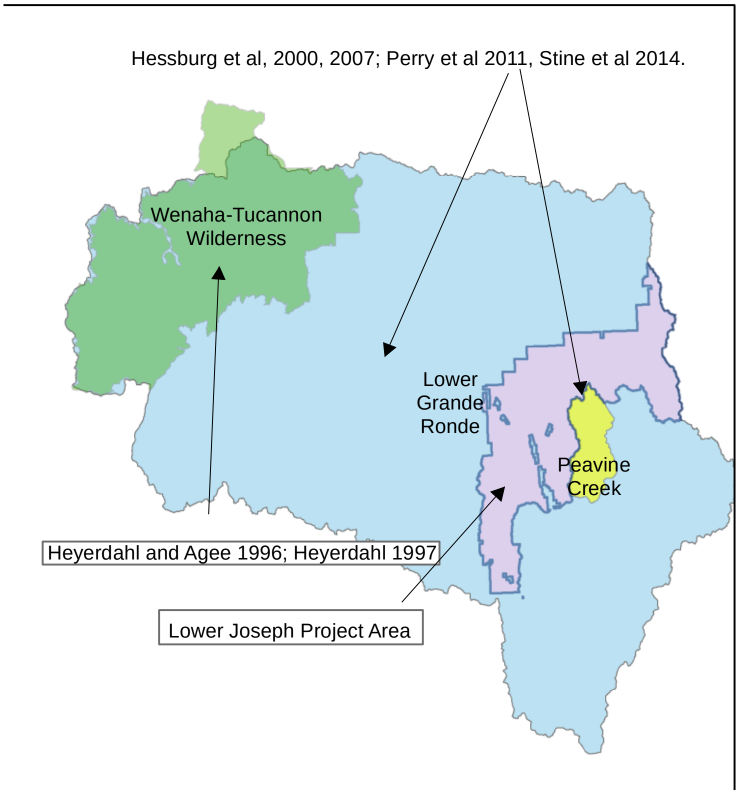


Figure V/D_1: Map showing relevant science references used to inform Lower Joseph range of variability assumptions, disturbance characteristics and treatment strategies.

The following are analysis topics and corresponding indicator specific to the vegetation resource. These analysis topics will be tracked throughout the effects analysis in order to address whether, or to what degree, the project meets purpose and need objectives.

Forested Vegetation – Percent Departure from Range of Variation (RV):

- Forested tree cover type
  Indicator: percent of upland forest potential vegetation group in each forest cover type
- Forested structural stages
  Indicator: percent of upland forest potential vegetation group in each forested structural stage
- Forested tree density class
  Indicator: percent of upland forest potential vegetation group in tree density classes

Forested Vegetation – Forest Pattern Similar to Historic Fire Regime

- Heterogeneous mosaic of tree clumps, individual trees, and openings
  Indicator: percent of forested landscape treated with ICO prescription

Forested Vegetation – Large Trees

- Tree size class distribution
  Indicator: tree size class distribution by upland forest potential vegetation group

Insects and Disease Susceptibility – Departure from RV (Schmitt and Powell 2008, Powell 2010)

- Insect and disease susceptibility rating (Schmitt and Powell 2005)
  Indicator: percent of upland forest potential vegetation group by susceptibility rating

Timber resource:

- Acres of harvest treatment
  Indicator: acres treated that remove timber volume
- Timber volume
  Indicator: timber volume removed as a result of restoration treatment

Wildland Fire Regime:

- Fire Regime

  Indicator: Fire Regime departure from desired extent (6 – 15% per year) and desired severity

- Fire Management Decision Space

  Indicator: Relative description of how wildland fire (planned or unplanned ignition) may be managed to meet resource objectives. Indicator is based on movement of the landscape toward natural disturbance regimes that promote typical fire severity and reference landscape conditions.

Methodology, Assumptions, Limitations

The base unit for characterizing vegetation conditions is the stand. All FS lands within the LJCRP area have been delineated into stands based on similar characteristics such as vegetation type, slope, aspect, tree density, species composition and management history. Stands vary in size, depending upon their uniformity, usually from 10 acres up to several hundred acres. Spatial and general vegetation information about each stand is stored in the Wallowa Whitman (WW) NF stand GIS layer.

The general vegetation information was supplemented with the WW Forest Plan Revision existing vegetation (EVG) data to create a baseline existing condition for potential vegetation group, forest cover type, forest structural stage, and tree size class.

Comprehensive stand and tree data was collected on a subset of the stands within the project area in 2008 as part of the Wallowa County Collaborative Lower Joseph Creek Watershed Assessment effort. Stand data collected includes ecoclass, structural stage, clumpiness and percent non-forest. Tree data collected and compiled for each inventoried stand includes basal area by age class/size class/tree species, damage and disease, surface fuels and snag densities.

The base vegetation information was then compared to the inventory data and aerial imagery (2011 NAIP) and edited as appropriate to most closely resemble the existing condition. This information was further verified based on local knowledge and field visits during the 2013 field season.

All of the stand information was then compiled into a project specific forest vegetation GIS database (LoJoVeg_EC_PA_PAEffects). This process allowed us to characterize the current stand conditions and determine the need for change and appropriate treatments based on the project purpose and need. A combination of field reconnaissance, GIS analysis and review of stand data was used to determine treatment needs, logging feasibility, and stand health (see the project record for more details on the development of the proposed action). Full definitions (data dictionary) of the attributes within the vegetation GIS layer may be found in Appendix B of this report.

Fire behavior methodologies and assumptions are found in Appendix D – Burn Probability Modeling Methods in this report and the FEIS.

Assumptions

The year 2014 is assumed to be the existing condition.

Any forest management treatments (tree cutting/removal, prescribed fire) are assumed to occur by the year 2024.

Prescribed treatments are based on the existing condition and the need to move those conditions toward desired conditions. The Silvicultural treatments prescribed follow the treatment decision matrix as documented in Appendix A. Adjustment to treatments may be made during implementation based on the actual conditions found on the ground. These adjustments would follow the treatment decision matrix that was used to determine treatments analyzed in this EIS.

Post treatment conditions are based on the existing forest condition and the silvicultural treatment applied to those conditions. The assumptions used to determine post treatment conditions are documented in Appendix B.

Limitations

The existing forest condition data is an average characterization of the conditions within the stand boundaries and is based on the best information currently available. The data accuracy is limited by the sources used to inform the characterization and the interpretations made by the analyst.

Post treatment conditions demonstrated in this analysis are an average characterization of relative change over time due to management actions or no action and are based on current ecological knowledge of forest response to management actions and forest succession.

Absolute conditions are neither intended nor implied for either the existing conditions or the post treatment conditions used in this analysis.

Affected Environment

Introduction

The Lower Joseph Creek Restoration Project (LJRCP) area contains NFS lands in the upper reaches of the Joseph Creek drainage, which is a tributary to the Grande Ronde River. The project area is characterized by deep forested canyons interspersed with very steep, grass-covered side slopes and jagged basalt outcrops. Vegetation of the LJCRP is generally composed of dry and moist coniferous forest (56% of project area), and grasslands and shrublands (43%). Elevations range from about 3600 to 5000 feet in the project area (NFS lands).

The Lower Joseph Creek watershed currently supports a mix of forests, ponderosa pine savannas, and grasslands. This mix of vegetation types has varied in relative abundance through time for tens of thousands of years (Mehringer 1996). Range of variation (RV) analysis is an analytical technique to characterize inherent variation in the composition, structure, and density of vegetation, reflecting recent evolutionary history and the dynamic inter-play of biotic and abiotic factors. "Study of past ecosystem behavior can provide the framework for understanding the structure and behavior of contemporary ecosystems, and is the basis for predicting future conditions" (Morgan et al. 1994). The historical range of variation (HRV) is meant to reflect ecosystem properties free of major influence by Euro-American humans, providing insights into ecosystem resilience (Kaufmann et al. 1994, Landres et al. 1999). RV helps us understand what an ecosystem is capable of, how historical disturbance regimes functioned, and inherent variation in ecosystem conditions and processes – the patterns, connectivity, seral stages, and cover types produced by ecological systems at a landscape scale. Ecosystems of the LJCRP developed with wildfire, insect outbreaks, disease epidemics, floods, landslides, human uses, and weather cycles. Change was, and still is, constant in their development, and HRV is designed to characterize the range of vegetation composition, structure, and density produced by these agents of change (Morgan et al. 1994), as well as other constraints like soils, topography, temperature, moisture, and others. Powell (2010) synthesizes literature and information on ranges of variation for Blue Mountains ecosystems, and represents the best available science for defining the characteristics of resilient ecosystems for the LJCRP.

Table V/D_1 summarizes the extent of potential vegetation groups (PVGs, (Powell et al. 2007)) in the project area. Potential vegetation groups are aggregations of plant associations found in the Blue Mountains (Johnson 1987, Powell and C.G.Johnson 2007) and represent a combination of temperature and moisture regimes. Given that plant associations are considered to be fairly homogeneous in terms of their growing environments, it is also assumed that potential vegetation groups will generally respond to management in a similar manner. Within each potential vegetation group, historical fire return intervals and severities vary, depending on several factors, such as fuel loadings, aspect, elevation, and weather conditions before and during fires (Heyerdahl 1997). Insect and disease frequencies and severities also vary, depending on species, vegetation density, and environmental factors. Approximately 40 plant associations were grouped into plant association groups (PAG), and potential vegetation groups (PVG) following procedures from Powell et al. (2007).

Potential vegetation groups (PVGs) of the LJCRP are almost equally split between grasslands and forests. Approximately 75% of the forests are dominated by the dry upland forest PVG, and 25% by the moist upland forest PVG. Dry upland forests are located at low to moderate elevations, and were historically dominated by ponderosa pine and Douglas-fir cover types (Table V/D_2). Cover types classify existing vegetation composition (Eyre 1980, Shiflet 1994), reflect majority or plurality tree species abundance, and apply to both pure and mixed stands. Compared to RV estimates, ponderosa pine is underrepresented in the dry PVG, while Douglas-fir, grand fir and lodgepole pine are overrepresented. In the moist PVG, lodgepole pine is underrepresented and Douglas-fir and grand fir are overrepresented. All other cover types are within RV estimates.

Table VD_1. Extent of major vegetation types in the Lower Joseph Creek Restoration project area

Physiognomic Type	Potential Vegetation Group	Acres	% of Project Area (Physiognomic Type)	% of Project Area (Potential Vegetation Group)
Conifer		55,700	56%	
	Dry upland forest (DUF)	42,300		43%
	Moist upland forest (MUF)	13,000		13%
	Other	400		<1%
Non-Conifer		42,300	43%	
	Cold upland herb	30		<1%
	Moist upland herb	4,200		4%
	Dry upland herb	37,000		38%
	Dry upland shrub	950		1%
	Other	140		<1%
Unknown				
Totals		98,000	100%	100%

Dry upland forests were historically characterized by predominantly frequent, low severity surface fires occurring at intervals of less than 20 to 25 years (Barrett et al. 1997). While larger-diameter, old trees typically survived these low severity fires, younger, smaller-diameter trees and less fire-tolerant species were killed. The historical fire regime created and maintained a generally open forest structure, with a small-scale mosaic pattern of clumps or patches of trees dominated by large diameter, old ponderosa pines, scattered individual trees, and openings that contained an abundance of native grasses and shrubs (Franklin et al. 2008, Larson and Churchill 2012, Churchill et al. 2013). This spatial heterogeneity is a key structural element of the historical dry upland forest (Franklin et al. 2008). Crown fires may have occurred historically in mid- to late-seral closed canopy structural stages. However, these events were limited in extent due to the predominance of open canopy forest (Barrett et al. 2010). The frequent fires in the dry upland forest potential vegetation group also contributed to relatively low fuel loadings.

The moist upland forest PVG is dominated by Douglas-fir, western larch, western white pine, grand fir, and sub-alpine fir (Table V/D_2), and generally located at moderate elevations. It is characterized by mixed-severity fires occurring every 40 to100 years. In a mixed-severity fire regime, fire severity ranges from stand-replacing crown fires that kill greater than 75% of overstory leaf cover to nonlethal, low-intensity surface fires that kill less than 25% of the overstory, or lack of fire that leave patches of living trees (e.g., as can currently be seen along parts of Cold Springs road). According to Perry et al. (2011), mixed-severity fires create a patchiness of forest structure, composition, and seral status that can be observed and quantified at an intermediate or meso-scale, with patch sizes ranging from a few hundredths up to tens or hundreds of acres, depending on locale and climatic drivers. Hessburg et al. (1999) measured patch sizes of uniform structure and composition from historic aerial photography from the 1930s for the ecological subregion including the LJCRP, and found patch sizes for moist (and dry) upland forests to range from approximately 10 to 600 acres. While forest management likely had affected vegetation pattern by the 1930s, it is the best source of data available on historic forest pattern. In forest types that were historically dominated by mixed-severity fire regimes, surface and canopy fuels, topography, climatic conditions, and ignitions worked in concert to influence variation in fire frequency, severity, spatial extent, and seasonality. The result was a complex spatial-temporal mix of low, moderate, and high severity patches. Due to patterns of burning, this type of historical fire regime created a complex mosaic pattern across the landscape, resulting in high levels of diversity in both plants and animals (Perry et al. 2011).

Table V/D_2. Current forest cover type distribution for the Lower Joseph Creek Restoration Project, and the natural range of variation in cover types for the Blue Mountains

Potential Vegetation Group	Cover Type	Acres	Percentage of Potential Vegetation Group	Range of variation (%) (Powell 2010)
Dry upland forest (UF)	Ponderosa pine	11,900	28%	50-80
Dry upland forest (UF)	Douglas-fir	21, 800	51%	5-20
Dry upland forest (UF)	Western larch	580	1%	1-10
Dry upland forest (UF)	Lodgepole pine	220	1%	0
Dry upland forest (UF)	Grand fir	7,500	18%	1-10
Dry upland forest (UF)	Engelmann spruce	20	<1%	0
Dry upland forest (UF)	Unknown	260	1%	

Potential Vegetation Group	Cover Type	Acres	Percentage of Potential Vegetation Group	Range of variation (%) (Powell 2010)
Dry UF Total		42,300	100%	
Moist upland forest (UF)	Ponderosa pine	1,400	11%	5-15
Moist upland forest (UF)	Douglas-fir	5,900	45%	15-30
Moist upland forest (UF)	Western larch	590	4%	10-30
Moist upland forest (UF)	Lodgepole pine	220	2%	25-45
Moist upland forest (UF)	Grand fir	4,700	36%	15-30
Moist upland forest (UF)	Engelmann spruce	130	1%	1-10
Moist upland forest (UF)	Unknown	40	<1%	
Moist UF Total		13,000	100%	
Grand Total		55,300		

Forest Structure

The basis for the forest structure classification system used in the Blue Mountains is the Oliver and Larson (1996) four stage system that was developed for conifer forests located west of the Cascade Mountains. This system was expanded to the eight class system (figure x) to include a wider spectrum of structural variation that exists within the drier eastside forests of Oregon and Washington (O'Hara et al. 1996). Figure V/D_2 illustrates and describes the forest structural stages for this analysis.

Description of Forest Structural Stages	
	**Stand Initiation (SI)**. Following a stand-replacing disturbance such as wildfire or tree harvest, growing space is occupied rapidly by vegetation that either survives the disturbance or colonizes the area. Survivors literally survive the disturbance above ground, or initiate new growth from their underground organs or from seeds on the site. Colonizers disperse seed into disturbed areas, it germinates, and then new seedlings establish and develop. A single canopy stratum of tree seedlings and saplings is present in this stage.

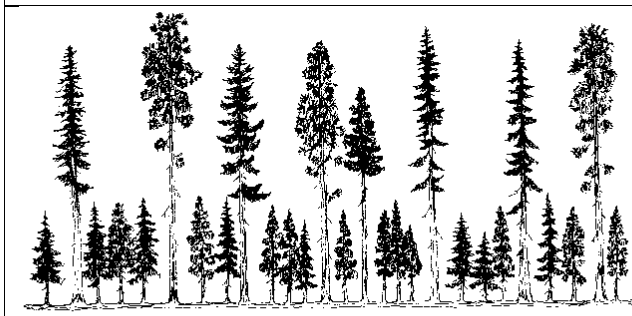
	**Stem Exclusion (SE)**. In this structural stage, trees initially grow fast and quickly occupy all of their growing space, competing strongly for sunlight and moisture. Because trees are tall and reduce light, understory plants (including smaller trees) are shaded and grow more slowly. Species needing sunlight usually die; shrubs and herbs may go dormant. In this stage, establishment of new trees is precluded by a lack of sunlight (**stem exclusion closed canopy**) or by a lack of moisture (**stem exclusion open canopy**).
 Visualize the UR illustration with another tree crown layer between the overstory and understory layer.	**Understory Reinitiation (UR)**. As the forest develops, a new age class of trees (cohort) eventually gets established after overstory trees begin to die or because they no longer fully occupy their growing space. Regrowth of understory seedlings and other vegetation then occurs, and trees begin to stratify into vertical layers. This stage consists of a low to moderate density overstory with small trees underneath. **Young Forest Multi-Story (YFMS)**. As succession progresses, three or more tree layers have become established as a result of minor disturbances (including tree harvest) that cause progressive but partial mortality of overstory trees, thereby perpetuating a multi-layer, multi-cohort structure. This class consists of a broken overstory layer with a mix of sizes present (large trees are scarce); it provides high vertical and horizontal diversity
	**Old Forest (OF)**. Many age classes and vegetation layers mark this structural stage containing large, old trees. Snags and decayed fallen trees may also be present, leaving a discontinuous overstory canopy. The drawing shows a single-layer stand of ponderosa pine reflecting the influence of frequent surface fire on dry-forest sites (**old forest single stratum; OFSS**). Surface fire is not as common onmoist sites or common on cold sites, so these areas generally have multi-layer stands with large trees in the upper-most stratum (**old forest multi strata; OFMS**).

Figure V/D_2. Description of forest structural stages.

Sources: Based on O'Hara and others (1996), Oliver and Larson (1996), and Spies (1997).

Table V/D_3 summarizes the existing forest structural stage percent and the estimated RV percent by potential vegetation group. Overall, the OFSS stage is rare and extremely underrepresented in the dry PVG while the OFMS and UR stages are overrepresented in both PVGs. The SE and SI stages are close to or within RV.

Table V/D_3 Distribution of forest structural stages in the Lower Joseph Creek Restoration Project area

<table>
<tr><th>Potential Vegetation Group</th><th>Structural Stage</th><th colspan="2">Acres</th><th colspan="2">Percentage of Potential Vegetation Group</th><th>Range of variation (%) (Powell 2010)</th></tr>
<tr><td rowspan="7">Dry UF</td><td>OFSS</td><td colspan="2">190</td><td colspan="2"><1%</td><td>40-60</td></tr>
<tr><td>OFMS</td><td colspan="2">8,300</td><td colspan="2">20%</td><td>5-15</td></tr>
<tr><td>YFMS</td><td>3,400</td><td rowspan="2">19,100</td><td>8%</td><td rowspan="2">45%</td><td rowspan="2">5-10</td></tr>
<tr><td>UR</td><td>15,700</td><td>37%</td></tr>
<tr><td>SE</td><td colspan="2">7,500</td><td colspan="2">18%</td><td>10-20</td></tr>
<tr><td>SI</td><td colspan="2">7,000</td><td colspan="2">17%</td><td>15-25</td></tr>
<tr><td>Unknown</td><td colspan="2">180</td><td colspan="2"><1%</td><td></td></tr>
<tr><td colspan="2">Dry UF Total</td><td colspan="2">42,300</td><td colspan="2">100%</td><td></td></tr>
<tr><td rowspan="7">Moist UF</td><td>OFSS</td><td colspan="2">40</td><td colspan="2"><1%</td><td>10-20</td></tr>
<tr><td>OFMS</td><td colspan="2">3,900</td><td colspan="2">30%</td><td>15-20</td></tr>
<tr><td>YFMS</td><td>2,000</td><td rowspan="2">4,700</td><td>15%</td><td rowspan="2">36%</td><td rowspan="2">10-20</td></tr>
<tr><td>UR</td><td>2,700</td><td>20%</td></tr>
<tr><td>SE</td><td colspan="2">2,300</td><td colspan="2">18%</td><td>20-30</td></tr>
<tr><td>SI</td><td colspan="2">2,000</td><td colspan="2">16%</td><td>20-30</td></tr>
<tr><td>Unknown</td><td colspan="2">20</td><td colspan="2"><1%</td><td></td></tr>
<tr><td colspan="2">Moist UF Total</td><td colspan="2">13,000</td><td colspan="2">100%</td><td></td></tr>
<tr><td>Grand Total</td><td></td><td colspan="2">55,300</td><td colspan="2"></td><td></td></tr>
</table>

Tree Density Class

Tree density is a characterization of tree stocking for an area. It expresses the number of tree stems occupying a unit of land. Stocking can be expressed as a “stand density index” or in some other measure of relative density, or it can be quantified in absolute terms as a number of trees per acre or as the amount of basal area, wood volume, or canopy cover on an area (Powell 1999).

Published stocking guidelines are available for evaluating tree density levels (Cochran et al. 1994; Powell 1999, 2009d). By using the stocking guidelines in conjunction with potential vegetation groups, it is possible to estimate how much forest-land acreage is currently overstocked and how it compares to a range of variation for this ecosystem component.

Currrently in the dry PVG, the high density class is overrepresented, the moderate density class is close to RV and the low density class is underrepresented. For the moist PVG, high is overrepresented and the moderate and low classes are within RV (Table V/D_4).

Table V/D_4. Distribution of tree density classes in the Lower Joseph Creek Restoration Project area

Potential Vegetation Group	Tree Density Class	Acres	Percentage of Potential Vegetation Group	Range of variation (%) (Powell 2010)
Dry UF	Dry High	14,200	33%	5-15
	Dry Mod	13,600	32%	15-30
	Dry Low	14,300	34%	40-85

	Unknown	180	<1%	
Dry UF Total		**42,300**	**100%**	
Moist UF	Moist High	5,800	45%	15-30
	Moist Mod	3,700	28%	25-60
	Moist Low	3,400	26%	20-40
	Unknown	50	<1%	
Moist UF Total		**13,000**	**100%**	
Grand Total		**55,300**		

Size Class Distribution

Tree size class is a diameter range characterizing a stands predominant situation with respect to tree size using diameter at breast height. For this analysis, size class represents the upper (overstory) size class meeting the minimum canopy cover threshold (10% for >20" and 20% for <20"). Within multi-age class structural stages (OFMS, YFMS, UR), it is an estimate of the largest overstory tree size while for single age class structural stages (SI, SE, OFSS) it is an estimate of the overall average tree size. Tree size class can be a general indication of site productivity, tree age (young, mature, old) and structural stage as well as habitat suitability.

Reference conditions for tree size class are related to, but not the same as those for structural stage. State-and-transition modeling was used to estimate the relative abundance of 5" tree size classes given historical disturbance regimes (FEIS Appendix C). Across all PVGs, the HRV for size classes were modeled to be: <5" dbh: 23% of the forested area; 5-10" dbh: 14%; 10-15" dbh: 20%; 15-20" dbh: 17%; >20" dbh: 26%. Current size class distribution within the project area (Table V/D_5) is dominated by the 10-15 and 15-20 inch diameter classes (66 percent of dry and 55 percent in moist). This is consistent with the cessation of natural fires approximately 100 years ago and the growth of trees that have regenerated since the time of cessation. The large tree (>20) size class represents sixteen percent of the dry PVG and twenty three percent of the moist. These percentages are largely due to the historic removal of the large tree component as well as the stand replacing fire events that occurred within the project area in the 1980s. One would expect a higher percentage in both PVGs to coincide with the old forest (OF) structural stage RV.

Table VD_5. Tree size class distribution in the Lower Joseph Creek Restoration Project area

Potential Vegetation Group	Tree Size Class (diameter range in inches)	Acres	Percentage of Potential Vegetation Group
Dry upland forest (UF)	<5	7,000	17%
	5-10	800	2%
	10-15	15,900	38%
	15-20	11,700	28%
	>20	6,700	16%
	Unknown	180	<1%
Dry UF Total		**42,400**	**100%**
Moist upland forest (UF)	<5	2,000	16%
	5-10	780	6%
	10-15	3,500	27%

	15-20	3,600	28%
	>20	3,000	23%
	Unknown	70	<1%
Moist UF Total		**13,000**	**100%**
Grand Total		**55,300**	

Pattern

Forest thinning prescriptions would follow a practical, science based approach intended to restore characteristic functionality, and resistance and resilience to disturbance. Known as "ICO" (individuals, clumps and openings), this approach uses historical information at the stand- and landscape-level to design restoration strategies and prescriptions for restoration (e.g., see (Franklin et al. 2013a)). For example, the pattern of old trees, stumps and snags currently on the landscape provide indicators of natural tree clumping and spacing, and thus the degree of horizontal spatial heterogeneity. In places where legacies of historic forest patterns are absent (e.g., young, post-fire forests), information is used from similar habitats.

Natural and Human-Caused Disturbance

Early logging on forest service lands was focused on removal of commercially valuable stands of old ponderosa pine (Munger 1917, Griffin 1918, Matz 1928). Generally, this caused replacement of stands of slower growing, old ponderosa pine with young, faster growing stands. Additionally, as the more drought tolerant and shade intolerant ponderosa pine was harvested, it was replaced in many areas by less drought tolerant species that are more shade tolerant, such as grand fir and Douglas-fir. The more open, single-storied ponderosa pine stands were converted to multi-storied stands. As stand densities increased and species compositions and forest structures were altered, the frequency and intensity of insect outbreaks increased. Under Blue Mountains' normal moisture-limited conditions, densely-stocked stands of grand fir and Douglas-fir trees become stressed, increasing their vulnerability to insect infestation. Similarly, on pine sites, multi-storied, densely stocked ponderosa pine stands are at risk of insect infestation under drought conditions. As these densely stocked and moisture-stressed stands became more abundant during the last half of the 20th century, localized insect infestations quickly blossomed into outbreaks covering thousands of acres (Gast et al. 1991, Spiegel and McWilliams 2014). Insects which attack Douglas-fir and grand fir include western spruce budworm (*Choristoneura occidentalis*), Douglas-fir tussock moth (*Orgyia pseudotsugata*), Douglas-fir beetle (*Dendroctonus pseudotsugae*), and fir engraver (*Scolytus ventralis*). Although insect outbreaks likely occurred prior to the time of the first Euro-American settlers, the frequency and size of outbreaks caused by western spruce budworm species and possibly other insects that attack Douglas-fir and grand fir appear to have increased as a result of the proliferation of fir-dominated forests (Swetnam et al. 1995)(Spiegel and McWilliams 2014). Similarly, the multi-storied ponderosa pine stands that replaced the single-storied stands on pine sites have also increased the potential for outbreaks of the western pine beetle (*Dendroctonus brevicomis*) and mountain pine beetle (*D. ponderosae*) (Hessburg et al. 1994, Spiegel and McWilliams 2014). During the past 50 years, tree mortality from insect disturbances in some stands has exceeded 80 percent of all overstory trees (Swetnam et al. 1995). Several large-scale insect outbreaks, including spruce budworm, spruce bark beetle, and Douglas-fir tussock moth, occurred from the 1970s to the 2000s and caused extensive defoliation and mortality. Most tree diseases are increasing in occurrence and severity due to changes in tree species composition (increased grand fir within the dry upland forest PVG), stand structures (increases in multi-storied structure), and increased stocking levels (Scott and Schmitt 1996). Although each outbreak was followed by an effort to salvage dead trees, low merchantability and limited access prevented removal of dead trees from many areas. The abundance of insect-killed trees substantially increased the surface fuel loads for thousands of acres across the Blue Mountains. Conditions became conducive for the occurrence of large, high-intensity wildfires. From 1985 until 1994, lightning-caused wildfires burned more than 445,000 acres in the Blue Mountains. Many of these fires were high severity, stand-replacing events that killed most of the trees across large areas. Within the project area, two notable wildfire events have occurred within the last 30 years. The 1986 Joseph Canyon/Starvation Ridge fire burned over 40,000 acres within the project area and the 1988 Tepee Butte burned almost 60,000 acres of which 1/3 was in the project area. A high percentage of these fires were stand replacing and resulted in the stand initiation phase of succession. Since 2004, three wildfire events occurred within the project area, burning a total of approximately 23,750 acres.

As a consequence of the past history of timber harvest, fire suppression, and grazing, the forests within the LJCRP are moderately different from those that existed a century ago (Munger 1917). Open, single-storied ponderosa pine stands have decreased, while dense, multi-storied stands of Douglas-fir and true fir have increased. Today, more stands are dominated by a uniform distribution of young to mid-aged trees as a result of selective harvesting of larger trees, salvage logging, and regeneration harvests that followed insect and fire mortality. The risk of insect outbreak has increased due to an abundance of densely stocked mixed-species stands. The probability of large, high-severity wildfire has also increased due to the increase in insect-induced tree mortality, increased fuel loadings, and the large more homogenous acreage of densely stocked, multi-storied stands composed of shade-tolerant and fire-intolerant tree species.

Insects and Disease

Ecosystem management and restoration strives to maintain an endemic level of insects and disease disturbance consistent with historical levels of activity within the range of variability for those plant communities providing resilience and adaptability for those systems. Insects and disease activity are important disturbance processes that create snags and down logs in the forested system. Trees with decay and mistletoe infestations provide habitat for a variety of forest-dwelling flora and fauna including microbes, fungi, invertebrates, small animals, and cavity nesting birds. During the past several decades, it has become increasingly more common for levels of insect and disease created disturbance to exceed pre-settlement conditions (Scott and Schmidt 1996). Campbell (1996) observed the following broad scale trends in the Blue Mountains that are applicable to the LJCRP area.

- Outbreaks of defoliating insects, such as western spruce budworm and Douglas-fir tussock moth, are now larger, more intense, and more frequent than in the past.
- Bark beetle related mortality, associated with tree stress and overstocked stands, is more prevalent.
- Drought in the late 1980s and early 1990s, coupled with overstocked stands, has contributed to increased mortality from bark beetles, other insects, fire, and disease.
- Many root diseases and dwarf mistletoes are more widespread and severe because of past management and the resulting change in forest structure and composition.

Insect and diseases common within the project area include:

<u>Defoliators</u> – Douglas-fir tussock moth *(Orgyia pseudotsugata)* and western spruce budworm *(Choristoneura occidentalis)* are evaluated together as a defoliators group. Several large-scale outbreaks of both species have occurred within the Blue Mountains from the 1970s to the 2000s and caused extensive defoliation.

The Douglas-fir tussock moth is a native defoliator of conifers (Douglas-fir and true fires) in western North America. Usually the first indication of attack appears in late spring. Larvae from newly hatched eggs feed on current year's foliage, causing it to shrivel and turn brown. By mid-July they may feed on both current and old foliage, although current needles are preferred. Defoliation occurs first in the tops of trees and the outermost portions of the branches, and then in the lower crown and farther back on the branches.

Western spruce budworm is a small native moth that feeds in the caterpillar stage on buds and developing conifer needles. In the Blue Mountains it feeds primarily on grand fir and Douglas-fir but will also feed on western larch, Engelmann spruce, and subalpine fir. The larvae feed on developing foliage in the early summer. Because current year growth is primarily consumed, it takes several years of defoliation for long-term impacts to occur. Areas within the LJCRP area did suffer impacts from a western spruce budworm epidemic that occurred within the Blue Mountains from about 1985 to 1993. Stands with Douglas-fir and grand fir with older dead tops and dead firs on the ground are evidence of prior budworm damage (Spiegel and McWilliams 2014).

Conifer forests with high susceptibility to defoliating insects are typically characterized as having low precipitation and persistent droughty conditions, a high proportion of host tree species, and a multi-layered canopy structure (Gast et al. 1991, Hessburg et al. 1999). Within the project area, the risk of budworm and Douglas-fir tussock moth outbreaks is currently higher than historically due to the presence of more host trees, primarily Douglas-fir and also grand fir, and dense, multilayered stands. Without management, these stands will continue to increase in density and stocking of shade-tolerant firs, increasing their risk to western spruce budworm and Douglas-fir tussock moth defoliation, damage, and mortality (Spiegel and McWilliams 2014).

<u>Douglas-fir beetle</u> – Douglas-fir beetle *(Dendroctonus pseudotsugae)* is the most destructive bark beetle pest of Douglas-fir. In the Blue Mountains, Douglas-fir is the principle host of the Douglas-fir beetle, although rarely, western larch is attacked. Douglas-fir beetle outbreaks are often associated with defoliator events, drought, fire or wind damage, old and diseased stands, and high stocking levels (Gast et al. 1991; Hessburg et al. 1999). Where such susceptible trees are abundant, once they have been infested and killed, beetle populations can build up rapidly and spread to adjacent green, standing trees. Damage is greatest in dense stands of mature Douglas-fir. Douglas-fir dominated stands and dry mixed-conifer stands with an interior Douglas-fir component are most likely to host Douglas-fir beetle outbreaks. Populations of Douglas-fir beetles are currently high on the Wallowa-Whitman and continued mortality is expected from this beetle while stands remain overstocked and droughty conditions continue (Spiegel and McWilliams 2014). See table V/D_6 for extent of recent Douglas-fir beetle activity within the project area.

<u>Fir engraver</u> – The fir engraver beetle *(Scolytis ventralis)* is the most important bark beetle of true firs in the Blue Mountains. It attacks and kills trees of nearly all age classes, from pole size to mature sawtimber (Gast et al. 1991). In addition to infesting standing green trees, the fir engraver will attack freshly cut logs and recent windthrows.

Elevated fir engraver beetle susceptibility is often associated with mixed conifer plant communities having a substantial component of grand fir and experiencing defoliator damage, drought, high stand density or root disease infestations (Gast et al. 1991; Hessburg et al. 1999). The extent of recent fir-engraver activity within the project area is listed in table V/D_6.

<u>Bark beetles in ponderosa pine</u> – The mountain pine beetle (Dendroctonus ponderosae) can reproduce in all species of pine within their range. Attacks by this beetle have also been associated with increased intertree competition and drought. In the 1970's the Blue Mountains experienced a widespread mountain pine beetle (Dendroctonus ponderosae) outbreak that resulted in the mortality of much of the older (over about 80 years old) lodgepole pine and some of the ponderosa pine as well. Within the project area, trees on the ground have been observed that show characteristic mountain pine beetle

galleries and are evidence of this past outbreak (Spiegel and McWilliams 2014). The Blue Mountains are currently experiencing another mountain pine outbreak. Again, they are killing most of the lodgepole trees over about 80 years old, and ponderosa pine in overstocked stands as well. There is currently some mountain pine beetle activity in the pines within the project area (Table V/D_6) and it can be expected to continue for several years where current ponderosa pine and lodgepole pine stand densities are above recommended densities (Spiegel and McWilliams 2014). For ponderosa pine, recommended stocking levels would be at or lower than the basal area for the Lower Management Zone by plant association as determined by Cochran et al. (1994) and Powell (1999). These recommendations are especially relevant to parts of the project area that, under a changing climate, can no longer support tree densities that they did historically.

Historically, western *(Dendroctonus brevicomis)* has caused the most damage in the California pine regions, but this insect has caused loss of ponderosa pine over the years in Oregon and Washington including the Blue Mountains (Gast et al. 1991). Western pine beetles typically breed in trees that are fire-damaged, drought stressed, or attacked by other agents such as mountain pine beetles or root disease. Large ponderosa pines are particularly susceptible where crowns are declining due to overly dense stands. They are at high populations currently due to recent drought. Managing stand density under the guidelines for mountain pine beetles will also reduce the risk from western pine beetles (Spiegel and McWilliams 2014). Where individual large, old pines are to be retained, Kolb et al. (2007) recommend thinning around these trees to increase resources to them.

<u>Douglas-fir dwarf mistletoe</u> - Douglas-fir dwarf mistletoe (*Arceuthobium douglasii* Engelmann) is a very common pathogen in the Blue Mountains and as such it is probably the greatest threat to long term successful management of Douglas-fir in the area. Forest Inventory data on the Wallowa Whitman NF indicates that 57 percent of the type is infected (Marsden et al.). Stands in the Douglas-fir plant community series with dominant components of susceptible hosts from early through late successional stages often have very high levels of infestation, with severe infection levels on individual trees. Stands in communities where Douglas-fir is a minor component or only became established late in succession, usually have incidental or scattered light dwarf mistletoe infections (Schmitt 1997). Based on inventory data, these trends hold true within the LJCRP project area.

<u>Root diseases</u> - Root diseases included in this group include laminated root rot *(Phellinus weirii)* and Armillaria root disease *(Armillaria ostoyae)*.

Laminated root rot is caused by the fungus, *Phellinus weirii.* This root disease causes severe damage in affected mixed conifer stands. Most of the disease's impact results in direct tree mortality and growth loss. Douglas-fir and grand fir are highly susceptible; western larch, subalpine fir and Engelmann spruce have an intermediate susceptibility and pine is tolerant (Gast et al. 1991).

Armillaria root disease is caused by the fungus, *Armillaria ostoyae*. This is one of the most common and damaging root diseases in the Blue Mountains. In active disease centers, trees are often killed outright or are frequently weakened and attacked by secondary pests. Site damage (i.e. soil compaction) and stresses to hosts generally increase the mortality caused by this pathogen (Spiegel and McWilliams 2014). All conifer species can be infected, but grand fir is among the most susceptible hosts while western larch and lodgepole pine are usually least affected (Gast et al. 1991). The highest incidence has been observed in moister plant communities. Armillaria root disease was confirmed within the project area killing Douglas-fir, grand fir, and small ponderosa pine (Spiegel and McWilliams 2014).

Table V/D_6 lists the areas acres of insect and disease activity within the LJCRP area from 2008 – 2013 as observed through annual aerial surveys

Table V/D_6. LJCRP forested acres affected by specific insects from 2008 to 2013.

Insect	Acres Affected					
	2008	2009	2010	2011	2012	2013
Douglas-fir Beetle	120	3,000	140	30	50	230
Fir Engraver	20	240	850	20	60	50
Mountain Pine Beetle – Ponderosa Pine	20	270	30	30	20	30
Mountain Pine Beetle – Lodgepole Pine	0	50	490	80	100	60
Western Pine Beetle	10	90	10	10	120	20

Insect and Disease Susceptibility

Susceptibility is defined as a set of conditions that make a forest stand vulnerable to substantial injury from insects or diseases. Susceptibility assessments do not predict when insects or diseases might reach damaging levels; rather, they indicate whether stand conditions are conducive to declining forest health, as indicated by increasing levels of tree mortality from insect and disease organisms.

Drought, ecological site potential (potential vegetation type), species composition and abundance, tree size, forest structure (canopy layering, structural stage), stocking (tree density), intra-stand variability (clumpiness), and other biophysical factors influence susceptibility and vulnerability to insect and disease disturbances (Hessburg et al. 1999, Lehmkuhl et al. 1994, Schmitt and Powell 2005).

Trees with increased insect or disease susceptibility often occur in dense forests where they face greater competition for soil moisture, nutrients, and other resources. For example, ponderosa pines in high-density stands have lower xylem water potentials and rates of photosynthesis, indicating greater drought stress (in this instance, high density causes physiological drought rather than climatic drought). These trees also have decreased resin production and foliar toughness, suggesting an increased susceptibility to insect and pathogen attack (Kolb et al. 1998).

To provide a process for evaluating insect and disease susceptibility, range of variation information was developed for nine insect and disease agents, and three classes of susceptibility (high, moderate, low), and it is stratified by potential vegetation group (Powell 2010).

Table V/D_7 lists the susceptibility ratings for the six insect and disease agents associated with the PVGs and cover types within the LJRPA. Current ratings for the dry upland forest PVG indicate conditions in the low rating are above RV for bark beetles in ponderosa pine; are below RV for defoliators, Douglas-fir beetle, fir engraver and Douglas-fir mistletoe; are within RV for root diseases. For the high rating, defoliators, Douglas-fir beetle, fir engraver and Douglas-fir mistletoe are above RV; bark beetles in ponderosa pine are below RV; root disease is within RV. For the low rating in the moist PVG, Douglas-fir beetle, fir engraver, bark beetles in ponderosa pine and Douglas-fir dwarf mistletoe are below RV; defoliators and root diseases are within RV. The high rating in the moist PVG indicates Douglas-fir beetle, fir engraver and Douglas-fir dwarf mistletoe are above RV; defoliators, bark beetles in ponderosa pine and root diseases are within RV.

Table V/D_7. Insect and disease susceptibility in the Lower Joseph Creek Restoration Project area

Potential Vegetation Group	Agent	Susceptibility Rating - % of Forested Area					
		Low		Moderate		High	
		Existing	RV Range	Existing	RV Range	Existing	RV Range
Dry upland forest (UF)	**Defoliators**	25%↓	40-85%	35%↑	15-30%	39%↑	5-15%

	Douglas-fir Beetle	15%↓	35-75%	39%↑	15-30%	45%↑	10-25%
	Fir Engraver	41%↓	45-90%	45%↑	10-25%	14%↑	5-10%
	Bark Beetles in P Pine	23%↑	5-10%	56%↑	15-30%	21%↓	40-90%
	Douglas-fir Dwarf Mistletoe	14%↓	25-55%	39%	15-40%	47%↑	20-35%
	Root Diseases	31%	30-60%	47%	25-50%	22%	5-25%
Moist upland forest (UF)	**Defoliators**	8%	5-10%	29%	20-30%	63%	35-90%
	Douglas-fir Beetle	5%↓	30-60%	23%	20-40%	71%↑	10-30%
	Fir Engraver	19%↓	30-70%	34%	20-35%	47%↑	10-20%
	Bark Beetles in P Pine	32%↓	40-70%	52%↑	15-35%	16%	5-25%
	Douglas-fir Dwarf Mistletoe	11%↓	30-65%	33%	20-45%	56%↑	10-20%
	Root Diseases	14%	5-15%	49%	20-50%	36%	35-75%

↓ less than RV; ↑ greater than RV

Characteristic levels of insect and disease activity consistent with the range of variability would contribute to diverse landscape conditions and provide important wildlife habitat components such as hollow trees, dead wood, and mistletoe brooms as well as opportunities for stand initiation and development through gap dynamics. The desired conditions for vegetation structure stand density, and species composition would create stand conditions with low to moderate susceptibility to insects and diseases across the majority of the upland forest PVGs within the Lower Joseph project area. These stand conditions result in an adaptable and resilient forest condition capable of absorbing disturbances while retaining the same basic structure and ways of functioning, the capacity of self-organization, and the capacity to adapt to stress and change.

Desired Conditions

This section describes the desired conditions for the LJCRP area, the differences between desired and existing conditions, and the need for the project. Desired conditions are based on scientifically-derived, ecologically-based reference conditions. Reference conditions (natural and/or historical ranges of variation) for forested vegetation, and disturbance processes have been estimated for the Blue Mountains National Forests through literature review (Powell 2012), and localized state-and-transition simulation modeling (FEIS Appendix C). Ecologically-based references for forest patterns were based on literature reviews, expert opinion, and quantitative analysis of historical patch size distributions from aerial photographs (Hessburg et al. 1999). The “Affected Environment” section provides more information on the ranges in reference conditions used in this EIS. These ranges of variation in conjunction with the Forest Plan and other policies and guidance, and collaboration with tribes, Wallowa County, and public were used as the primary basis for developing the desired conditions for the LJCRP.

One key ecological factor making up the foundation for analysis of departure between current and desired conditions, and the need for restoration is ecosystem resilience. Highly resilient ecosystems are better able to survive natural disturbances such as fire, insects, diseases, and climate change (USDA Forest Service 2013b) than less resilient ones. Ecosystems are most resilient and resistant to disturbance when they are similar to conditions under which they developed over the long term (Morgan et al. 1994). A system in which natural levels of variation have been reduced will be less resilient to change than one exhibiting more natural variation (Holling and Meffe 1996). By restoring and maintaining natural ranges of ecosystem structures and functions, forest health and sustainability, and ecological resilience will be improved across the landscape. Information about historical ranges of variation often provides the best, if not the only, indication of natural, ecologically sustainable ranges of variation. Broad-scale assessments completed for the Blue Mountains physiographic province and the interior Columbia River basin suggest that upland forest ecosystems could be characterized as healthy, sustainable, and resilient if three of their ecosystem components – species composition, forest structure, and tree density – are within the natural, or historic range of variation (NRV, HRV), which developed under historical disturbance regimes (Gast et al. 1991, Caraher et al. 1992, Lehmkuhl et al. 1994, Quigley et al. 1996).

Table V/D_8 compares existing and desired conditions for a suite of representative indicators of ecological health and resilience, and socioeconomic contributions to human communities. This project is expected to move the Lower Joseph Creek landscape toward a more desirable[1], resilient condition to support lasting human resource uses, forest structure and pattern, forest health, natural disturbance regimes, vegetation composition and diversity, fish and wildlife habitat, soil productivity, and watershed function. It also aims to maintain healthy and restored conditions for future generations.

Table V/D_8. Comparison of existing and desired conditions of selected attributes for the Lower Joseph Creek Restoration project area

Indicator	**Metrics**	**Units**	**Existing condition**	**Long-term desired condition**
Vegetation structure and composition	Ponderosa pine cover type (% of dry upland forest)	%	28	50-80
	Douglas-fir cover type (% of dry upland forest)	%	51	5-20
	Old forest single story structure (% of dry upland forest)	%	0	40-60
	Old forest single story structure (% of moist upland forest)	%	0	10-20
	Young forest and understory reinitiation structure (% of dry upland forest)	%	45	5-10
	Young forest and understory reinitiation structure (% of moist upland forest)	%	36	10-20

[1] In general, desired conditions are based on 1) what is assumed to be natural ranges of variation, 2) Forest Plan and other guidance, and 3) local socioeconomic and ecological contexts.

	High density class (% of dry upland forest)	%	33	5-15
	High density class (% of moist upland forest)	%	45	15-30
Vegetation pattern	% of forest treated with an "individuals, clumps, and openings" prescription based on natural stand patterns	% foreste d area	0	100
Insects and Pathogens	% of dry upland forest highly susceptible to defoliators	%	39	5-15
	% of dry upland forest highly susceptible to Douglas fir beetle	%	45	10-25
	% of dry upland forest highly susceptible to Douglas-fir dwarf mistletoe	%	47	20-35
Ecological resiliency – fire	% Fire regime (vegetation departure) departure from HRV summarized at 5th field watershed level	%	29-39	<33

Disturbance regimes

This section describes the affected environment related to insects, disease, and wildland fire and their contribution to ecological resilience. Resilience is defined as the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change (FSM 2020.5). An ecologically resilient landscape is less susceptible to uncharacteristic wildfire (Averill et al. 1995, Gunderson 2000, Walker et al. 2004), is at lower risk from uncharacteristic insect and disease infestations and epidemics, provides a full range of habitats for native terrestrial and aquatic species, protects water quality and abundance, provides a full range of habitats for native terrestrial an aquatic species, protects water quality and abundance, provides a full range of uses, products and services, and is more adaptable to changes in climate.

Disturbance processes including fire, insects, diseases and wind, were, and continue to be significant drivers of ecosystem resilience (Agee 1993, Agee and Maruoka 1994) and agents of change in vegetation structure, composition, density, and pattern. Wildland fire is critical to ecological restoration of fire adapted systems and can be used as a tool to manage natural resources. The influence of these disturbance processes can provide ecological benefit as well as impacts.

A fire regime is a generalized description of the role fire plays in the ecosystem (Agee 1993). It includes characteristics of frequency, severity, and seasonality of fire. The historical fire regime is describe according to fire severities that occurred before significant European influence began in approximately 1850 (Jaindl and Quigley 1995) and includes fire ignited by Native Americans. Fire regimes, especially fire frequency and intensity, strongly influence which species will prevail in the vegetation composition of a given area, along with biophysical conditions. Fire has been a significant process within the LJCRP area historically and is essential to proper ecosystem function. Management can mimic the effects of fire through actions such as timber harvest, prescribed fire, or managing wildfire but not always at the same frequency or scale as the historical disturbance regime. Land managers have the ability to choose, to some extent, what relationship with fire is desirable (Agee and Maruoka 1994). Table V/D_9 describes fire regimes grouped into classes of frequency and severity.

Table V/D_9. Description of fire regime groups (from Barrett et al 2010).

Fire Regime Group	Frequency (years)	Severity	Severity Description
I	0 - 35	Low / Mixed	Generally low-severity fires replacing less than 25% of the dominant overstory vegetation; can include mixed-severity fires that replace up to 75% of the overstory
II	0 - 35	Replacement	High-severity fires replacing greater than 75% of the dominant overstory vegetation
III	35 - 200	Mixed / Low	Generally mixed-severity; can include low severity fires
IV	35 - 200	Replacement	High-severity fires
V	200+	Replacement / any severity	Generally replacement-severity; can include any severity type in this frequency range

Fire Regime Departure

Hann et al. 2003 described amount of departure (percent) from historical fire regime and vegetation conditions through the fire regime condition class tool. This tool was developed to compare historic natural vegetation, associated disturbance regimes, and current vegetation succession classes to identify the amount of departure from historical conditions. This analysis will utilize departure versus the simplified condition classes; however the underlying principles are utilized to describe departure from vegetative range of variability and historic disturbance regime when compared to existing landscape condition. The larger the departure percent indicates a greater need for ecological restoration of disturbance processes and vegetation management.

The existing condition and successional trends in vegetation in the LJCRP is similar to those described for the larger interior Columbia River basin (Quigley et al. 1996). Data shows that the Blue Mountains are dominated by upland forest ecosystems that evolved with frequent fire, low and mixed severity fire; the LJCRP is likewise dominated by this type of disturbance frequency and severity. The non-forest areas within the Joseph Creek project historically supported frequent fire with mixed to replacement severity fire. Much of the Lower Joseph project area is characterized by low to moderate departure from historical conditions.

Natural and human-caused disturbance

Natural disturbances are those under which ecosystems developed and were maintained over the long-term (Hardy et al. 2001, Schmidt et al. 2002). Fire is the dominant natural disturbance regime in the project area. Disturbance regimes (e.g., fire, insects, disease, and weather events, including droughts and floods) can be described as a combination of frequencies and severities. Fire regime groups, naturally-occurring combinations of fire frequency and severity (Barrett et al. 2010), are a relevant way to describe fire regime conditions and effects at the scale of the LJCRP. Table V/D_9 describes the characteristics of fire regime groups. Tables V/D_10 and V/D_11 compare desired and existing fire regimes, and probabilities of different fire severities for the major vegetation types within the project area. Current fire severity probabilities were modeled specifically for this project area (see Appendix D for modeling methods). This model uses historical fire ignition points and weather recorded for the day of the start. It does not model the 97th percentile extreme weather events that may coincide with fire ignition. This is especially important in the moist upland forest (13% of the LJCRP area) when considering the existing burn probability and the wide margin for average return intervals for each fire severity class (Table V/D_11). Desired probability and average interval were derived from Landfire Rapid Assessment modeling and validated by local experts.

As a consequence of the past timber harvest, fire suppression, introduction of non-native plant species, and livestock grazing, the national forests within the Blue Mountains are substantially different from those that existed a century ago (Munger 1917). Dry upland forests (43% of the LJCRP area) have experienced the greatest amount of departure from historical conditions. Fire history research across the Blue Mountains and western United States has provided support for local efforts to establish historical fire return intervals through fire and mechanical means (Hall 1977, Crane and Fischer 1986, Agee and Maruoka 1994, Maruoka and Agee 1994, Heyerdahl and Agee 1996, Heyerdahl 1997, Olson 2000, Stephens et al. 2009, McIver et al. 2012). Dry upland forests have now missed several natural fire cycles due to over a century of fire exclusion and suppression, which has resulted in increases in fuel loadings and the number of smaller trees. The departure in dry forests from the historic range of variation (HRV) in the HCNRA, in-part due to past wildfire, generally differs from the rest of the LJCRP area in that there is a greater abundance of younger forests in need of increased structural diversity and growth toward larger size classes. Additionally, historic grazing removed the fine fuels that carried low severity surface fires. Without competition from grasses, tree regeneration increased substantially. Tree regeneration that historically would have been thinned by fire continued to grow into dense stands and form multi-storied, closed canopies. The historically open stands within dry upland forest, with their mosaic pattern of tree clumps or patches and openings, have now filled in with younger trees, resulting in a more uniform stand structure, increased ladder fuels, increased stand densities, increased fuel continuity, and decreased spatial heterogeneity. Increased stand densities and a reduction in low severity fire events on dry sites have also contributed to a shift from shade intolerant, fire tolerant tree species, such as ponderosa pine and western larch, to more shade tolerant, fire intolerant species, such as grand fir. Increased stand densities have also contributed to a decrease in the abundance and diversity of understory grasses, forbs, and shrubs.

Shifts in the vegetation structure and composition of dry forests (single to multi-storied), density (ingrowth), and composition (increase of shade tolerant species) affect fire severity in several ways including increasing the likelihood of replacement severity crown fire due to increased fuel loading and reduction in distance between surface and canopy fuels (ingrowth + multi-story + increased landscape continuity). An increase in fire intolerant species such as grand fir along with the densification of forest stands likewise increases severity ratings due to each species relative resistance to fire (composition). An increase in fire intolerant species will result in higher fire severity ratings due to their susceptibility to mortality as a result of fire. Fire severity describes the effect of fire to the upper level canopy cover (Barrett et al. 2010) in terms of the range of replacement. Table V/D_12 shows the severity classes and their respective levels of replacement.

Moist upland forest is one of the most variable PVGs in the Blue Mountains relative to species composition. Therefore it is also variable in associated disturbance regimes (frequency, severity and size). Fire behavior and effects to overstory vegetation are strongly related to seasonal drought stress, topography, existing cover composition and over-riding climatic factors, such as El Nino Southern Oscillation (ENSO) influences. Additionally the relative juxtaposition of these forests in relation to lower elevation dry upland forest and non-forest (grass and shrubland) influence the composition, frequency of disturbance and severity to overstory vegetation. The biophysical landscape within LJCRP indicates a high interrelationship between dry and moist upland forest and non-forest disturbance. Relatively frequent low to mixed severity fire would be expected to occur more often and replacement severity fire to occur more infrequently than indicated in Table V/D_12 in moist upland forest, especially at the blended edge between dry and non-forest. In general, replacement severity regimes in moist upland forests usually results in heterogeneous landscapes. Large, high-severity fires are usually rare events, and may affect large areas (10,000-100,000 acres), but subsequent mixed-severity fires are important for creating the landscape heterogeneity. Within these landscapes a mix of stand ages and size classes are important characteristics; generally the landscape is not dominated by one or two age classes (Stine et al. 2014).

Moist upland forests in the project area currently have a higher potential for replacement severity fires than historically or desired, and the effects of replacement fires are uncharacteristic relative to those typical of fire regime group III (Table V/D_10). Fire return intervals have been missed but not to the same degree as the dry upland forest. However fuels accumulation rates in moist forests far exceed those of dry forests due to higher productivity soils. This means it takes less missed return intervals to create an uncharacteristic fuel loading and resultant fire behavior.

To restore fire-related disturbance regimes toward desired conditions in the LJCRP area, fuels must be strategically reduced in appropriate locations. Tools available to reduce fuels include thinning toward more natural forest structures, and the ecologically- and socially-appropriate use of planned and unplanned fire.

Table V/D_10. Desired and existing fire regimes for the major vegetation types within the project area (Adapted from Barrett et al. 2010 and Stine et al. 2014).

Vegetation Type	Existing Fire Regime (see table 29)	Desired Fire Regime (see table 29)	Description
Dry Upland Forest	Fire Regime Group III (IIIa)	Fire Regime Group I	Existing fire regime displays a higher proportion of the landscape experiencing moderate/mixed severity fire than characteristic of the vegetation type. Restoration of forest characteristics including fuel reduction will move the landscape towards a higher percent of low severity fire although some mixed and high would still be a desirable part of the vegetation type.
Moist Upland Forest	Fire Regime Group III (IIIb/IIIa)	Fire Regime Group III (IIIa)	Existing fire regime displays a higher proportion of replacement severity in this vegetation type than desired in the LJCRP. Effects would be uncharacteristic when compared to the desired Fire Regime Group of IIIa that is typified by the majority of moist upland forest that exists in the LJCRP area as described by Stine et al. 2014. Fire return intervals have been missed but not at the same magnitude as the dry upland forest (DUF), however fuels accumulation rates far exceed DUF due to higher productivity soils. This means it takes less missed return intervals to create an uncharacteristic fuel loading and resultant fire behavior.
Non-Forest	Fire Regime Group II	Fire Regime Group II	The non-forest systems are dominated by replacement severity fire disturbance that consumes the majority (>75%) of the overstory vegetation (e.g. grass, shrub, etc.). The

Vegetation Type	Existing Fire Regime (see table 29)	Desired Fire Regime (see table 29)	Description
			bunchgrasses, however, rarely die in fires, and most of the shrub species, with the exception of sagebrush and bitterbrush are rhizomatous and root/crown sprout after fire. Fire effects to overstory vegetation have not departed from historical or desired conditions; however, grazing and presence of invasive species have changed the system such that certain areas are highly vulnerable to undesirable effects from fire . Fire exclusion in these areas has been effective in creating a similar number of missed intervals as the dry upland forest sites as evidenced by the intermixing of the landscape in grass tree mosaic and extensive lithosol areas. Lithosol communities produce little biomass and probably had less frequent fires than other grasslands, but pre- and post-fire vegetation is very similar (this does not include the rigid sage portions of the lithosols, which if burned take years to recover).

Table V/D_11. Severity class and effects to upper level canopy replacement.

Severity Class	Effects
No Fire Effects	< 5 percent replacement
Low (non-lethal)	6 – 25 percent replacement
Mixed (mixed severity)	26 – 75 percent replacement
Replacement (stand replacement)	> 75 percent replacement

Table V/D_12. Existing and desired severity probabilities for the dry and moist upland forest potential vegetation groups.

Fire severity class	Existing Probability (% of all fires)	Historical Severity Probability (% of all fires)	Average Interval (years)
Dry upland forest (DUF)			
Replacement	5	5 – 14	115 – 125
Moderate/Mixed	49	13 – 21	50 – 75
Low	46	64 – 82	8 - 25
Moist upland forest (MUF)			
Replacement	3	14 – 35	125 – 200
Moderate/Mixed	47	21 – 47	75 – 150
Low	52	18 – 64	25 – 50

A prioritization strategy for prescribed fire has been developed that identifies high, moderate, and low ecological priorities for re-introducing fire to the forested system (Table V/D_13). In RNAs there would be no prescribed fire authorized unless it is part of a formal research proposal. The LJCRP is not a formal research proposal thus no prescribed fire would be planned within these areas.

While this prioritization can be used to locate the most socially and ecologically appropriate locations to use fire to meet the purpose and need of the LJCRP, it does not exclude implementing fire in the lower priority areas. This is particularly true where the landscape has a high degree of interaction and spatial connection amongst these areas. Prior to implementation burn plans would be developed in an interdisciplinary setting to maximize ecological benefit providing for public and fire personnel safety and ease of control.

Table V/D_13. Prioritization scheme for identifying the highest ecological benefit to re-introduce fire.

Prioritization Level[1]	Description
High	All mechanical treatment acres are included in high priority for prescribed fire. Findings in McIver et al (2012) indicate the importance of using prescribed fire and mechanical vegetation treatment together when restoration of fire adapted systems is part of the desired condition. All dry upland forest acres are included.
Moderate	Acres of moist upland forest that do not receive forest vegetation treatments. There is growing recognition that moist forest systems, that are spatially influence and interconnected with dry upland forest, exhibit similar disturbance regimes (Stine et al. 2014). These areas provide opportunities in the LJCRP to restore fire as an ecological process that shapes composition, density, structure and pattern to meet desired landscape condition.
Low	Acres designated as non-forest vegetation that do not have harvest of SI treatments. Restoration of the forested system is the objective of the LJCRP. These acres represent the lowest priority to use prescribed fire as a restoration tool for forest resilience. It is recognized that these areas are important to the overall landscape and influence fire spread and behavior and portions would be included in all prescribed fire activity.

1/ Project Design Criteria also influence where prescribed fire can be used (see FEIS chapter 4 and FEIS Appendix J).

This prioritization scheme is related to the ecological need and objectives within the forested system of LJCRP. Additional information such as location to wildland urban interface, highly valued resources (administrative sites, campgrounds, lookouts, etc.), grazing allotment management, sensitive animal or plant habitat, or Forest Plan management direction would need to be considered to maximize ecological and social benefit and efficiently utilize limited time and resources. These factors would be considered during preparation of burn plans prior to implementing prescribed fire.

In addition to fire disturbance, insects and diseases are also a natural disturbance with a characteristic frequency and severity in the project area. Under the Blue Mountains' normal moisture-limited conditions, densely-stocked stands of grand fir and Douglas-fir trees species, while differing in some ecological traits, both become stressed. This increases their vulnerability to insect infestation, and in the case of Douglas-fir, mistletoe infestation. Similarly, on pine sites, multi-storied, densely stocked ponderosa pine stands are at risk of insect infestation under drought conditions. These densely stocked and moisture-stressed stands have become more abundant during the last half of the 20th century, and localized insect infestations have quickly blossomed into outbreaks covering thousands of acres (Gast et al. 1991). Table V/D_7 summarizes susceptibility to insect and disease mortality for the LJCRP. Although insect outbreaks likely occurred prior to the time of the first Euro-American settlers, the frequency and size of outbreaks caused by western spruce budworm species and possibly other insects that attack Douglas-fir and grand fir appear to have increased as a result of the proliferation of fir-dominated forests (Swetnam et al. 1995). Similarly, the multi-storied ponderosa pine stands that replaced the single-storied stands on pine sites have also increased the potential for outbreaks of the western and mountains pine beetles (*Dendroctonus brevicomis*, and *D. ponderosae*, respectively) (Hessburg et al. 1994). During the past 50 years, tree mortality from insect disturbances in some stands has exceeded 80 percent of all overstory trees (Swetnam et al. 1995). Most tree diseases are increasing in occurrence and severity due to changes in tree species composition (increased grand fir within dry upland forest), stand structures (increases in multi-storied structure), and increased stocking levels (Scott and Schmitt 1996). The abundance of insect-killed trees has substantially increased the surface fuel loads for thousands of acres across the Blue Mountains. Conditions became conducive for the occurrence of large, high-intensity wildfires. From 1985 until 1994, lightning-caused wildfires burned more than 445,000 acres in the Blue Mountains. Many of these fires were high severity, stand-replacing events that killed most of the trees across large areas. Within the project area, two notable wildfire events have occurred within the last 30 years. The 1986 Joseph Canyon/Starvation Ridge fire burned over 40,000 acres within the project area and the 1988 Tepee Butte burned almost 60,000 acres of which 1/3 was in the project area. A high percentage of these fires were stand replacing and resulted in the stand initiation phase of succession. Since 2004, three wildfire events occurred within the project area, burning a total of approximately 23,750 acres.

To restore insect- and disease-related disturbance regimes in the LJCRP area, and move toward desired conditions, forest densities and species composition must be strategically restored in appropriate locations. Tools available to reduce uncharacteristic insect and disease disturbance include thinning toward more natural forest structures, and the ecologically- and socially-appropriate use of planned and unplanned fire. For more detail on insects and diseases of the project area, see “Affected Environment”, FEIS Chapter 2.

Historically, disturbance from timber harvest has differed from natural disturbances in its frequency, severity, pattern, and what remains on the landscape following tree harvest. Techniques to increase the similarity between human and natural disturbances have improved greatly over the past few decades (Diaz and Apostol year?, Franklin et al. 2013a).

The severity, extent, and seasonality of planned and unplanned fire can range from being very similar to natural fire disturbance to being very different. Fire suppression is a human-caused disturbance that, in most cases, alters the natural fire process, except where it is used to mitigate uncharacteristic fire severity, which could result from over abundant fuel loads. To reduce departure between the effects of human and natural disturbance processes, human-caused and natural disturbance frequencies, patterns, and intensities need to be more aligned. Tools available to reduce this departure include the use of ecologically-informed tree harvest and fire prescriptions.

Environmental Consequences

Spatial and Temporal Context for Project Level Effects Analysis

For the vegetation/disturbance regime effects analysis the spatial context being considered is the 98,600 acres of Forest Service lands within the project area. The baseline year used for this analysis is the year 2014 as the existing condition. In this analysis, all past activities and events are included in the existing condition description. In the effects discussion, post treatment refers to the time the final activity is accomplished (year 2024), "short-term" effects refers to effects over the 10-year period from the time the final activity was accomplished (year 2034). Beyond 20-years we will be considering effects as "long-term" (year 2054).

Direct and Indirect Effects - Alternative 1 (No Action)

Alternative 1 is the no action alternative as required by 40 CFR 1502.14(c). There would be no changes in current management and the forest plans would continue to be implemented. Alternative 1 is the point of reference for assessing action alternatives 2 and 3.

In the short term, distribution of forest cover type, forest structural stages and tree density class under alternative 1 would be expected to be similar to existing conditions (see tables in affected environment section). The following is a narrative discussion of change over time based on the current trajectory.

Forest Cover Type

In the short term, western larch in the dry PVG and ponderosa pine in the moist PVG would remain within the desired range. All other cover types in the dry and moist PVGs would be outside RV percentages. Conditions would continue to favor Douglas-fir and grand fir. Seral species (ponderosa pine and western larch) would continue to stagnant and decline moving farther outside RV.

Forest Structural Stages

The dry PVG stand initiation and stem exclusion structural stages would remain within RV percentages. All other dry PVG and all moist PVG structural stages would be outside the desired range. Successional pathways from stand initiation to old forest would continue. Tree growth would slow in areas of high stocking. Forest structure will continue to be outside of RV and favor multi-storied conditions.

Tree Density Class

Within the moist PVG, the moderate and low density classes would remain within the desired range in the short term. The percent of the landscape in the moist high and all density classes in the dry PVG would be outside of the RV. Overstocked conditions would continue. Tree growth would continue to slow and density related mortality will increase. Moderate and high density classes would increase as the low density classes transition to moderate, and moderate shift to high, further moving away from the desired RV percentages.

Pattern

In the absence of cutting, pattern would continue to favor continuous tree crowns with small canopy gaps associated with insect and disease pockets. Forest canopy would continue to increase, shading out understory herbaceous vegetation and further reducing forage production and species diversity. Historic grasslands, savannas and forest openings would continue to become smaller.

Size Class Distribution

The forested landscape would remain dominated by trees in the 10 to 20 inch size classes. Trees would continue to grow toward the next higher size class. Individual tree growth would slow and where overstocked conditions occur, movement from one class to the next will be inhibited.

Disturbance and Fire Regime

There would be no direct effects to disturbance regimes or fire severity under Alternative 1.

Fire suppression has been and would continue to be implemented in the LJCRP area under Alternative 1. Given current and expected fire suppression activities less than 2% of the LJCRP landscape is affected by fire on average per year. On modeled high fire years approximately 15 – 20 percent burns at once. The historical range of acres affected by fire in any given year is approximately 6 – 15 percent.

In the absence of forest restoration treatment and utilization of unplanned ignitions to increase the decision space for fire management, the conditions described in the affected environment would continue to depart from desired conditions. The landscape would continue to become less resilient to disturbance (including changing climate). Disturbance regimes would continue to shift from relatively frequent low/mixed severity disturbance towards relatively infrequent moderate/high severity. The landscape would continue to homogenize in density and structure creating a more continuous fuel environment that has the potential to support larger more intense disturbance effects. The shift from fire tolerant to intolerant species and fire suppression could create conditions that select against regeneration of early seral fire tolerant species (a key ecosystem component) at the scale of the project.

In the event of a large high severity fire occurring in the LJCRP following the increase in fuel accumulation, insect mortality, and shift from early to late seral species there is the potential to affect many ecosystem components including existing early seral old trees and wildlife habitat features.

Alternative 1 does not meet the purpose and need of the project because there would be no restoration of structure, density, composition or patter, thus no restoration of disturbance processes at the landscape scale. Disturbances will continue to increase in severity and potentially size depending on conditions (fire weather) under which they occur.

Fire Management Decision Space

Alternative 1 would not reduce the ecological or political risk of utilizing unplanned ignitions to meet landscape restoration goals. Selection of this alternative would not improve fire management decisions as a result of restoration activities that are designed to more closely resemble natural fire regimes and effects.

Insects and Disease

Insect and diseases that thrive in overstocked, stem exclusion or understory reinitiation structural stages and with host species of Douglas-fir and grand fir would increase. Susceptibility of ponderosa pine and western larch would increase as conditions favoring these species deteriorate and they become more stressed.

Dwarf mistletoe and degree of mistletoe infestation - Without the removal of infected trees, reduction of host trees, or creation of conditions that minimizes potential for spread to uninfected trees, it is expected that existing dwarf mistletoe infections would intensify and spread.

Other Direct and Indirect Effects:

Yarding and Fuel Treatment

There would be no harvest or yarding of material. There would be no fuel treatments that reduce understory stocking, reduce inter-tree competition, or stimulate understory vegetation (shrubs, forbs, grass). There would be no fire control line construction. There would be no cutting treatments, therefore, there would be no activity fuels in need of treatment. Natural fuels would not be reduced, and would continue to accumulate.

Timber Resource

There would be no harvest treatment (0 acres treated that remove timber volume) and there would no timber volume (0 cubic feet) removed as a result of restoration treatments.

Road Maintenance, Reconstruction, Temporary Road Construction, Closure and Decommissioning

Road maintenance would continue at current levels. No construction of temporary roads, opening closed roads or reconstructing roads would occur. Vegetation development (ingrowth and mortality) within current road rights of way would continue on the current trajectory.

Road closure and decommissioning of 52 miles of roads would allow ingrowth of forest vegetation once the road is decommissioned (approximately 156 acres). Possible management actions associated with above listed activities includes: Reestablish former drainage patterns, stabilizing slopes, and restore vegetation; Block the entrance to a road or installing water bars; Remove culverts, reestablish drainages, remove unstable fills, pull back road shoulders, and scatter slash on the roadbed; Completely eliminate the roadbed by restoring natural contours and slopes; and Other methods designed to meet the specific conditions associated with the unneeded road.

Aquatic Passage

There is no aquatic passage activities associated with Alternative 1.

Hazard Tree Falling

There are no harvest operations or road work associated with harvest activities in Alternative 1, therefore there is no hazard tree felling in association with harvest operations and road work.

Direct and Indirect Effects Common to All Action Alternatives

The Forest Service proposes to implement activities across the approximately 98,600 acre LJCRP area to meet the purpose and need. Silviculture treatments would provide a diversity of forest structures that are more in line with desired conditions, and more resilient to anticipated future environmental conditions. Forest thinning prescriptions would follow a practical, science based approach intended to restore characteristic functionality, and resistance and resilience to disturbance. Known as "ICO" (individuals, clumps and openings), this approach uses historical information at the stand- and landscape-level to design restoration strategies and prescriptions for restoration (e.g., see (Franklin et al. 2013a)). For example, the pattern of old trees, stumps and snags currently on the landscape provide indicators of natural tree clumping and spacing, and thus the degree of horizontal spatial heterogeneity. In places where legacies of historic forest patterns are absent (e.g., young, post-fire forests), information is used from similar habitats.

Thinning, and mechanical fuel treatments would encourage the development of large tree structural characteristics, understory plant diversity, forage productivity, and resilience to disturbances such as wildfire. Thinning of largely younger trees across additional acres, which are in the process of recovery after stand replacement disturbance, would encourage the development of spatial heterogeneity and increase the proportion of early seral tree species. Silvicultural treatments would generally retain and protect large trees of early seral species and trees with old growth physical characteristics consistent with historical reference conditions. Regeneration of openings that result from the ICO thinning and regeneration openings associated with the group selection treatment type would rely on natural regeneration of conifer species. Within the units with a group selection treatment type, there may be a need to plant the regeneration openings to ensure the prescribed post treatment stocking and species mix is attained.

Prescribed burning using planned and unplanned ignitions of natural fuels, where ecologically appropriate, on up to 90,000 acres, would reduce fuel loads, increase understory productivity and diversity, allow fire to perform its natural ecological role, and reduce uncharacteristic disturbance from wildfire, insects, and disease.

All action alternatives would aim to foster the re-introduction of planned and unplanned fire where it would be ecologically beneficial. In addition, this EIS will analyze the relative effects of the range of alternatives on fire behavior, recreation values at risk of unwanted fire, departures in forest structure and composition between current and reference conditions, wildlife habitat, threatened and endangered aquatic and terrestrial species, aquatic and riparian habitat, grassland extent, forage availability for domestic livestock, dead and down wood, snags, fuels, and wildlife habitat.

Connected actions that would be included in the analysis include road maintenance, and hazard tree cutting or removal. Fuels associated with silvicultural treatments (activity fuels) would be treated with a suite of available tools including, but not limited to, mastication, removal, grapple or hand pile and burn, cutting and scattering limbs, or prescribed fire.

Features specific to the desired condition objectives have been designed into the proposed action and alternatives to prevent impacts and meet the forest plans standards and guidelines as amended under this EIS, and meet the project purpose and need. The comprehensive silviculture design is documented in the Silvicultural and Rx Fire Design - Appendix A of this report.

Disturbance and Fire Regime

Harvest, stand improvement, and prescribed fire (planned and unplanned ignition)

Treatments under both action alternatives are designed to use evidence based ecologically informed principles to restore function and processes and appropriate disturbance regimes in a landscape created by disturbance. Following guidelines found in Franklin et al. (2013) and local range of variability estimates inform how disturbance regimes regulated forest structure and composition and contributed to landscape resilience. The two action alternatives manipulate forest structure, density, and composition as well as landscape pattern in a way to reduce uncharacteristic disturbance due to density dependent mortality (insects) and compositional influenced mortality (disease and fire). These treatments also lead to a reduction in uncharacteristic moderate and replacement severity fire as a result of an increase in fire-intolerant species, decreased abundance of fire-tolerant species, multi-storied stands that increase ability of fire to influence canopy fuels, and densification of forest stands across the landscape that increase the continuity and amount of fuel across the LJCRP area.

Prescribed fire as a silvicultural tool is critical to restoring health, resiliency adaptability and process to the forested landscape within LJCRP. Franklin et al. (2013) indicate that fire will be a constant in the dry forests of eastern OR and WA and will neither be eliminated nor would it be desirable to do so. Both action alternatives recognize the ecological need to manage fire (planned and unplanned) to meet the purpose and need of this project and to move the landscape towards more resilient conditions while mitigating undesirable effects of higher proportions of unnaturally high severity fire. There would be areas of mixed severity that provide opportunities to regenerate early seral species at the stand and landscape scale. These opportunities may vary in size from < 1 acre to 10's of acres. These conditions would affect the LJCRP at an ecologically important scale for the types of forested systems found in the project area.

Under the two action alternatives up to 90,000 acres of prescribed fire would be available for implementation. It is anticipated that some of this would be done using planned ignitions but realizing the limitation of burn windows, cost, and personnel this project encourages the use of unplanned ignitions so long as it is exhibiting fire behavior conducive to meeting the restoration objectives described in Chapter 1.

Planned ignition priority areas are identified for the action alternatives and described in the project design features for this document. High priority areas represent the acres that are treated with either harvest or SI, or are in the dry upland forest potential vegetation group. Prescribed fire following harvest or SI serves to "complete" the first restoration step by mechanically moving forest structure, density, or composition towards the reference conditions as well as returning fire as a natural disturbance process to create natural patterns of heterogeneity. On acres treated with a combination of cutting and fire the departure from the natural fire regime will be moved toward desired conditions.

On high priority areas outside harvest and stand improvement (SI) areas, wildland fire would be used to alter forest density, structure, composition, and pattern. In general, density would be reduced due to small diameter tree mortality to canopy consumption or cambium scorch, and this would move the landscape closer to RV and begin to restore natural disturbance regimes. Improving large and old forest structure would occur by fire supporting restoration of old or early seral trees species of large size and reducing the number of smaller diameter young trees within the stand. Early seral tree species would be favored (not killed) by fire due to their inherent adaptive strategies to survive fire (thick bark, self-thinning crown, etc). Returning fire to the system is a direct way to influence the restoration of reference conditions, disturbance regimes, and reference patterns on the landscape. There would be areas of mixed severity fire (similar to a group selection harvest) that would provide the necessary environment to successfully regenerate early seral species across the landscape, a characteristic that is currently underrepresented. The moderate priority areas are located in the moist upland forest potential vegetation group and would experience a higher relative probability of moderate/replacement severity fire. Low priority areas are dominated by non-forest vegetation and are not critical to meeting the forested vegetation portion of the restoration objectives.

Activity Fuels

Activity fuels, slash and brush derived from cutting in the harvest and SI treatments, would create a short term increase in fuel accumulation and potentially increase the severity of wildfire should it occur prior to fuel treatments. Activity fuels would be treated in a variety of ways including, but not limited to, mastication, removal, pile (grapple or hand) and burn, cutting and scattering limbs, or prescribed fire.

Fire Management Decision Space

The action alternatives provide options for fire management to utilize planned and unplanned ignitions to influence the resilience and restoration of the LJCRP by reducing the amount of uncharacteristic fire severity, albeit to differing degrees. The primary difference between the action alternatives in this respect is the indirect effect of limiting fire management opportunities under alternative 3 by no harvesting or conducting SI work in IRA, PWA, designated old growth or RHCAs. Alternative 2 prepares more acres for the re-introduction of fire and therefore gives more options for using fire to protect important resource values such as old trees, late and old structure forests, riparian habitat conservation areas, wildlife habitat, IRA characteristics, PWA characteristics, or designated old growth. Alternative 3 treats less acres overall and in particular the areas that have the greatest social concern for harvest or SI. By eliminating treatment in the IRA, PWA, RHCA, and designated old growth under alternative 3 these areas would continue to develop structure, density, and composition that present a higher proportion of uncharacteristically severe wildfire such that it limits the decision space and comfort of fire management to allow planned or unplanned fire to reclaim its role as a restorative process both within these areas and areas immediately adjacent to and outside that would also benefit from fire.

Treatment Types

Table V/D_14 describes the treatment types that are proposed in the action alternatives. See Appendix A of this report for the decision matrix used to determine treatment type and intensity to move project area toward RV.

Table V/D_14 – Description of treatment types

Treatment Types	**Treatment Description**
Savanna	Reestablishment of grassland/forest edges and historic grasslands that have conifer encroachment.
Single Tree Selection (STS)	ICO variable density thinning within all age classes present
Group Selection (GS)	ICO variable density thinning within all age classes present; ½ to 4 acre group selection to initiate new cohort of seral species (PP/WL).
Intermediate Treatment (IT)	ICO variable density thinning within all age classes present with emphasis on isolating mistletoe infections and creating conditions that reduce intensification of infection.

Stand Improvement (SI)	ICO variable density thinning within young, post disturbance stands.

The STS, GS and IT treatment types have a treatment intensity associated with them (high, moderate, low) indicating a post treatment desired density class. Table V/D_15 illustrates the change from existing density class to post treatment density class based on treatment intensity.

Table V/D_15. Relationship of treatment intensity to the desired post treatment density class

		Treatment Intensity:		
	Post Treatment Density Class ↘	High	Moderate	Low
Existing Density:	High	*Low*	*Moderate*	*High*
	Moderate		*Low*	*Moderate*
	Low			*Low*

Direct and Indirect Effects - Alternative 2

See FEIS Chapter 3 for a complete description of alternative 2. Table V/D_16 lists the cutting treatments proposed under alternative 2, approximate acres for each treatment and the percent of the total treatment acres each treatment type represents. The following is a list and description of other treatments that are proposed for alternative 2 and are not listed in the description of treatment type table (above).

- Single Tree Selection in MA15 –similar to other single tree selection treatments with emphasis on old growth characteristics.
- Meadow Restoration – removal of young trees that have encroached onto meadow complex adjacent to Swamp Cr.

A total of 21,170 acres of cutting treatments are proposed. Moderate and high intensity single tree selection treatment types account for almost half of the treatment acres and stand improvement (non-sawlog) treatments add another 25 percent. Under this alternative, approximately 39 percent of the forested acres within the project area would have a cutting treatment.

Within the 2,430 acres of units with a group selection treatment type, there may be a need to plant approximately 500 acres to ensure the prescribed post treatment stocking and species mix is attained.

Table V/D_16. Alternative 2 – Acres by cutting treatment type in the Lower Joseph Creek Restoration Project area

Treatment Type	Approximate Acres	Percent of Treatment Acres (Percent of Forested Acres)
Stand Improvement	5,400	25%
Single Tree Selection – High Intensity	4,800	23%
Single Tree Selection – Moderate Intensity	5,800	26%
Single Tree Selection – Low Intensity	1,200	6%
Single Tree Selection in MA15 – Moderate Intensity	650	3%
Single Tree Selection in MA15 – Low Intensity	10	<1%
Group Selection – High Intensity	1,800	9%
Group Selection –Moderate Intensity	590	3%
Group Selection – Low Intensity	40	<1%

Treatment Type	Approximate Acres	Percent of Treatment Acres (Percent of Forested Acres)
Intermediate Treatment – High Intensity	120	1%
Intermediate Treatment – Mod Intensity	120	1%
Intermediate Treatment – Low Intensity	90	<1%
Savanna*	530	3%
Meadow Restoration* (Swamp Creek)	31	≤1%
Cutting Treatment Total (Forested Acres)	**21,170 (20,610)**	**100% (37%)**
Forested Acres – No Cutting Treatment	**34,690**	**(63%)**
Total Forested Acres	**55,300**	**(100%)**

*Savanna and meadow restoration treatments are in areas that do not meet the definition of forested.

Logging systems to be used to accomplish tree harvest within the Alternative 2 proposed harvest units and the associated acres are listed in Table V/D_17. Specific design features and best management practices for each logging system are listed in FEIS Appendix J.

Table V/D_17. Alternative 2 Acres by Logging System

Logging System	Approximate Acres	Percent of Total Harvest Treatment Acres
Ground Based (Tractor)	6,200	39%
Line	4,500	29%
Helicopter	5,000	32%
Total Harvest Acres:	15,700	100%

Forest Cover Type

Cover type percent by potential vegetation group and percent change from existing due to alternative 2 treatments are listed in table V/D_18. The prevalent effect in terms of movement toward RV would be in the ponderosa pine cover type. There would be a ten percent increase in the dry PVG and another 2 percent increase in the moist PVG. There would also be notable changes to the Douglas-fir cover type with a nine percent reduction in the dry PVG and a 2 percent reduction in the moist PVG. Overall, alternative 2 would move all cover types in both PVGs closer to RV with the exception of lodgepole pine in the moist PVG.

Table V/D_18. Alternative 2 – Post treatment distribution of forest cover types in the Lower Joseph Creek Restoration Project area

Potential Vegetation Group	Cover Type	Acres	Percentage of Potential Vegetation Group (Percent Change from Existing)	Range of variation (%) (Powell 2010)
Dry upland forest (UF)	Ponderosa pine	16200	38% (+10)	50-80
	Douglas-fir	18,000	42% (-9)	5-20
	Western larch	720	2% (+1)	1-10
	Lodgepole pine	90	<1% (-<1)	0
	Grand fir	7,000	16% (-2)	1-10
	Engelmann spruce	0	0% (0)	0

	Unknown	260	1%	
Dry UF Total		**42,300**	**100%**	
Moist upland forest (UF)	Ponderosa pine	1,700	13% (+2)	5-15
	Douglas-fir	5,600	43% (-2)	15-30
	Western larch	760	6% (+2)	10-30
	Lodgepole pine	170	1% (-1)	25-45
	Grand fir	4,600	36% (-<1))	15-30
	Engelmann spruce	70	1% (-<1)	1-10
	Unknown	40	<1%	
Moist UF Total		**13,000**	**100%**	
Grand Total		**55,300**		

Forest Structural Stages

Table V/D_19 summarizes the forest structural stage percent by potential vegetation group and percent change from existing due to alternative 2 treatments. Highest movement toward RV would be in the OFSS structural stage with a six percent increase in the dry PVG and 2 percent increase in moist. The SE stage would experience movement away from RV in both PVGs. Overall, alternative 2 would result in movement toward RV in OFSS and SI and movement away from RV in all other stages. This is due to the time lag of development from the UR/YFMS structural stages to the OF structural stages and illustrates the need for continued management as the UR/YFMS stages mature in order to further move the percentage of dry PVG OFSS stage within RV.

Table V/D_19. Alternative 2 – Post treatment distribution of forest structural stages in the Lower Joseph Creek Restoration Project area

<table>
<tr><th>Potential Vegetation Group</th><th>Structural Stage</th><th colspan="2">Acres</th><th colspan="2">Percentage of Potential Vegetation Group (Percent Change from Existing)</th><th>Range of variation (%) (Powell 2010)</th></tr>
<tr><td rowspan="7">Dry UF</td><td>OFSS</td><td colspan="2">2,600</td><td colspan="2">6% (+6)</td><td>40-60</td></tr>
<tr><td>OFMS</td><td colspan="2">9,000</td><td colspan="2">21% (+1)</td><td>5-15</td></tr>
<tr><td>YFMS</td><td>2,700</td><td rowspan="2">19,300</td><td>6%</td><td rowspan="2">46% (+1)</td><td rowspan="2">5-10</td></tr>
<tr><td>UR</td><td>16,600</td><td>39%</td></tr>
<tr><td>SE</td><td colspan="2">3,700</td><td colspan="2">9% (-9)</td><td>10-20</td></tr>
<tr><td>SI</td><td colspan="2">7,500</td><td colspan="2">18% (+1)</td><td>15-25</td></tr>
<tr><td>Unknown</td><td colspan="2">180</td><td colspan="2"><1%</td><td></td></tr>
<tr><td colspan="2">Dry UF Total</td><td colspan="2">42,300</td><td colspan="2">100%</td><td></td></tr>
<tr><td rowspan="7">Moist UF</td><td>OFSS</td><td colspan="2">220</td><td colspan="2">2% (+2)</td><td>10-20</td></tr>
<tr><td>OFMS</td><td colspan="2">4,300</td><td colspan="2">33% (+3)</td><td>15-20</td></tr>
<tr><td>YFMS</td><td>1,800</td><td rowspan="2">4,700</td><td>14%</td><td rowspan="2">36% (+<1)</td><td rowspan="2">10-20</td></tr>
<tr><td>UR</td><td>2,900</td><td>22%</td></tr>
<tr><td>SE</td><td colspan="2">1, 700</td><td colspan="2">13% (-5)</td><td>20-30</td></tr>
<tr><td>SI</td><td colspan="2">2,100</td><td colspan="2">16% (+<1)</td><td>20-30</td></tr>
<tr><td>Unknown</td><td colspan="2">20</td><td colspan="2"><1%</td><td></td></tr>
<tr><td colspan="2">Moist UF Total</td><td colspan="2">13,000</td><td colspan="2">100%</td><td></td></tr>
<tr><td>Grand Total</td><td></td><td colspan="2">55,300</td><td colspan="2"></td><td></td></tr>
</table>

Tree Density Class

Table V/D_20 displays the density class percent by potential vegetation group and percent change from existing due to alternative 2 treatments. Overall, alternative 2 would move or maintain all density classes within RV for both PVGs.

Table V/D_20. Alternative 2 – Post treatment distribution of tree density classes in the Lower Joseph Creek Restoration Project area

Potential Vegetation Group	Tree Density Class	Acres	Percentage of Potential Vegetation Group (Percent Change from Existing)	Range of variation (%) (Powell 2010)
Dry UF	Dry High	6,400	15% (-18)	5-15
	Dry Mod	9,500	22% (-10)	15-30
	Dry Low	26,300	62% (+28)	40-85
	Unknown	180	<1%	
Dry UF Total		**42,300**	**100%**	
Moist UF	Moist High	3,300	25% (-20)	15-30
	Moist Mod	5,200	39% (+11)	25-60
	Moist Low	4,400	34% (+9)	20-40
	Unknown	50	<1%	
Moist UF Total		**13,000**	**100%**	
Grand Total		**55,300**		

Pattern

Alternative 2 would treat 21,400 acres using the Individuals, Clumps and Openings (ICO) approach to restoring forest spatial pattern.

Size Class Distribution

Thinning treatments would result in an immediate increase in average tree diameter by favoring dominant and codominant trees. The treatments would also increase average tree diameter in the short term by reducing intertree competition and improving individual tree growth.

Table V/D_21 displays the estimated post treatment size class distribution and the percent change from the existing distribution. For both the dry and moist PVGs, tree size class would be trending toward larger tree size classes with a nine and seven percent increase respectively in the >20 size class.

Table V/D_21. Alternative 2 - Tree size class distribution in the Lower Joseph Creek Restoration Project area

Potential Vegetation Group	Tree Size Class (diameter range in inches)	Acres	Percentage of Potential Vegetation Group (Percent Change from Existing)
Dry upland forest (UF)	<5	5,300	13% (-4)
	5-10	2,900	7% (+5)
	10-15	10,700	25% (-13)
	15-20	12,500	30% (+2)
	>20	10,700	25% (+9)
	Unknown	180	<1%

Dry UF Total		42,300	100%
Moist upland forest (UF)	<5	1,500	11% (-5)
	5-10	1,400	11% (+5)
	10-15	2,700	21% (-6)
	15-20	3,400	26% (-2)
	>20	3,900	30% (+7)
	Unknown	70	<1%
Moist UF Total		**13,000**	**100%**
Grand Total		**55,300**	

Disturbance and Fire Regime

See "Effects common to all action alternatives", above. The action alternatives vary in effect based solely on intensity of treatment represented by the number of acres. Alternative 2 includes more acres of harvest and SI, thereby directly improving forest structure, density, and composition and associated fire regime characteristics.

Prescribed fire (planned and unplanned)

Alternative 2 has more area identified as a high priority for prescribed fire (48,600 acres) than Alternative 3 (46,500 acres), primarily due to the relatively greater forest area treated mechanically, and thus needing activity fuels treatment. Alternative 2 has the largest beneficial impact on fire regime departure and landscape resiliency by burning approximately 4 to 6 percent of the landscape per year compared to the reference of 6 – 15 percent and in high fire years approximately 5 – 10 percent is predicted to burn. This is within the reference fire regime and expected natural burn pattern insofar as the area adapting to and with fire as a disturbance process.

Activity Fuels

There would be more activity fuels created with the implementation of Alternative 2 as compared to Alternative 3. The treatment of activity fuels in "Effects common to all action alternatives" remains the same. Disposition of activity fuels is a key part in ensuring that fire severity does not increase due to the additional accumulation of fuels as a result of silvicultural activity. There is no increased impact to fire risk under Alternative 2 when compared to Alternative 3.

Fire Management Decision Space

Alternative 2 creates the most decision space of the action alternatives to manage wildland fire (planned and unplanned ignitions). State-and-transition modeling for the LJCRP area (Appendix C) indicates that during a high fire year in the LJCRP area the amount of the landscape that burns is within the expected fire regime extent (6-15%/year). Although there is no difference between expected acres intentionally burned with planned and unplanned ignitions, (4 – 6%) depending on the year, there is a large benefit to managing unplanned ignitions under Alternative 2 due to the active management of IRA, PWA, Designated Old Growth, and RHCAs. This creates an environment with less ecological and social risk of having unwanted fire effects such as uncharacteristically severe fire or fire affecting a large portion of the area (particularly within or adjacent to IRA, PWA, Designated Old Growth, and RHCAs) in one year such as to impact the character of forest succession and fire regime. Alternative 2 positively affects the ability of wildland fire to become a restorative process at an ecologically appropriate scale and severity.

Insects and Disease Susceptibility -

Table V/D_22 lists the estimated, alternative 2 post treatment susceptibility ratings for the six insect and disease agents associated with the PVGs and cover types within the LJCRP area. The following is a comparison of expected post treatment ratings to existing ratings, as an indication of stand conditions that are conducive to improved forest health (trending toward RV).

Dry PVG

- Defoliators and Douglas-fir beetle would be outside RV for all ratings, with a higher percentage in the low and moderate ratings and lower percentage in the high rating than existing
- Fir engraver would be the same as existing for all ratings
- Bark beetles in ponderosa pine would be outside RV for all ratings, with a lower percentage in the low and high ratings and a higher percentage in the moderate rating
- Douglas fir mistletoe would be outside RV for the low and high ratings and within RV for the moderate rating with no change from existing for all ratings.
- Root diseases would be within RV for the low and high ratings and outside RV for the moderate rating. The low and moderate ratings are higher and the high rating is lower than existing

Moist PVG

- Defoliators would be within RV for all ratings. The low rating is higher, the moderate rating is the same and high rating is lower than existing.
- Douglas-fir beetle would be outside RV for the low and high ratings and within RV for the moderate rating. The low and moderate ratings are higher, and the high rating is lower than existing.
- Fir engraver would be outside RV for all ratings. The low and moderate ratings are higher and the high rating is lower than existing.
- Bark beetle in ponderosa pine would be outside RV in the low and moderate rating and within RV for the high rating. The low and high ratings are lower than and the moderate rating is higher than existing.
- Douglas-fir dwarf mistletoe would be outside RV for all ratings. The low rating is higher, the moderate rating is the same and high rating is lower than existing.
- Root diseases would be outside RV for all ratings. The low and moderate ratings are higher and the high rating is lower than existing.

Table V/D_22. Alternative 2 – Post treatment insect and disease susceptibility in the Lower Joseph Creek Restoration Project area

Potential Vegetation Group	Agent	Susceptibility Rating - % of Forested Area					
		Low		Moderate		High	
		Post Trt.	RV Range	Post Trt.	RV Range	Post Trt.	RV Range
Dry upland forest (UF)	**Defoliators**	31%+	40-85%	45%+	15-30%	24%-	5-15%
	Douglas-fir Beetle	17%+	35-75%	53%+	15-30%	29%-	10-25%
	Fir Engraver	41%=	45-90%	45%=	10-25%	14%=	5-10%
	Bark Beetles in P Pine	22%-	5-10%	59%+	15-30%	19%-	40-90%
	Douglas-fir Dwarf Mistletoe	14%=	25-55%	39%=	15-40%	46%=	20-35%
	Root Diseases	34%+	30-60%	52%+	25-50%	14%-	5-25%

Moist upland forest (UF)	**Defoliators**	10%+	5-10%	29%=	20-30%	61%-	35-90%
	Douglas-fir Beetle	6%+	30-60%	30%+	20-40%	64%-	10-30%
	Fir Engraver	20%+	30-70%	37%+	20-35%	43%-	10-20%
	Bark Beetles in P Pine	28%-	40-70%	64%+	15-35%	8%-	5-25%
	Douglas-fir Dwarf Mistletoe	12%+	30-65%	33%=	20-45%	55%-	10-20%
	Root Diseases	22%+	5-15%	56%+	20-50%	22%-	35-75%

+ increase from current; - decrease from current; = same as current.

Dwarf Mistletoe and the Degree of Mistletoe Infestation - Design criteria common to all treatment types, includes discriminating against mistletoe infected trees, discriminating against host species (Douglas-fir) and creating conditions that minimize potential for spread to uninfected trees. This would result in a reduced mistletoe infection wherever mistletoe infections occur within the 21,400 acres of cutting treatment proposed under alternative 2. This includes 340 acres of cutting treatment in moderate to heavily mistletoe infected stands.

Alternative 2 Other Direct and Indirect Effects:

Yarding and Fuel Treatment

Some damage to the residual trees would be expected with the felling, yarding and piling operations within 15,700 acres of mechanical treatments. Damage would be minimized through contract administration and proper harvest methods. Burning treatments on 48,600 acres of high priority areas would reduce understory stocking and reduce inter-tree competition as well as stimulate understory vegetation (shrubs, forbs, grasses). Fire control lines would use existing features with naturally low fuels, skid trails, roads etc. as much as possible. Actual construction of control lines would remove herbaceous material to bare mineral soil.

Timber Resource

There would be approximately 15,700 acres of harvest treatment (acres treated that remove timber volume) and there would be approximately 10,400,000 cubic feet of timber volume removed as a result of restoration treatments. This would be a direct beneficial effect of Alternative 2.

Road Maintenance, Reconstruction, Temporary Road Construction, Closure and Decommissioning

Road maintenance within the existing road prism would have no effect on the health and growth of the leave trees within the treatment units. Reconstructing 82.6 miles of road will remove trees and forest vegetation within the area being reconstructed (approximately 250 acres). Constructing 12.6 miles of temporary roads will remove trees and forest vegetation within the road right of ways (approximately 40 acres). Road closure and decommissioning of 69 miles of roads would allow ingrowth of forest vegetation once the road is decommissioned (approximately 210 acres). Possible management actions associated with above listed activities includes: Reestablish former drainage patterns, stabilizing slopes, and restore vegetation; Block the entrance to a road or installing water bars; Remove culverts, reestablish drainages, remove unstable fills, pull back road shoulders, and scatter slash on the roadbed; Completely eliminate the roadbed by restoring natural contours and slopes; and Other methods designed to meet the specific conditions associated with the unneeded road.

Aquatic Organism Passage Improvements

Replacing 6 culverts to improve aquatic organism passage may remove trees and forest vegetation directly within the area of associated construction. The area affected adjacent to each culvert is approximately .5 acre for a total of 3 acres.

Hazard Tree Cutting

The cutting and removal of hazard trees in association with Alternative 2 harvest operations and road work may reduce old trees and large trees adjacent to these activities. The limited number of hazard trees is not expected to have an overall effect on cover type, forest structure, density class or size class distribution.

Direct and Indirect Effects - Alternative 3

See Chapter 3 for a complete description of alternative 3. Table V/D_23 lists the cutting treatments proposed under alternative 3, approximate acres for each treatment and the percent of the total treatment acres each treatment type represents. A total of 13,340 acres of cutting treatments are proposed. Moderate and high intensity single tree selection treatment types account for 61 percent of the treatment acres and stand improvement (non-sawlog) treatments add another 22 percent. Under this alternative, approximately 24 percent of the forested acres within the project area would have a cutting treatment.

Compared to the proposed action (alternative 2), alternative 3 proposes 2,400 less acres of stand improvement, 5,220 less acres of STS/GS/IT treatments, 240 less acres of Savanna treatments, and 0 acres of meadow restoration.

Within the 880 acres of units with a group selection treatment type, there may be a need to plant approximately 200 acres to ensure the prescribed post treatment stocking and species mix is attained.

Table V/D_23. Alternative 3 – Acres by cutting treatment type in the Lower Joseph Creek Restoration Project area

Cutting Treatment Type	Approximate Acres (Change from Alt. 2)	Percent of Forested Area Treated
Stand Improvement	3,000 (-2,400)	5%
Single Tree Selection – High Intensity	3,700 (-1,100)	7%
Single Tree Selection – Moderate Intensity	4,400 (-1,400)	8%
Single Tree Selection – Low Intensity	820 (-380)	1%
Single Tree Selection in MA15 – Moderate Intensity	0 (-650)	0%
Single Tree Selection in MA15 – Low Intensity	0 (-10)	0%
Group Selection – High Intensity	380 (-1,420)	1%
Group Selection –Moderate Intensity	470 (-120)	1%
Group Selection – Low Intensity	30 (-10)	<1%
Intermediate Treatment – High Intensity	70 (-50)	<1%
Intermediate Treatment – Mod Intensity	50 (-70)	<1%
Intermediate Treatment – Low Intensity	80 (-10)	<1%
Savanna*	290 (-240)	1%
Meadow Restoration* (Swamp Creek)	0 (-31)	0%
Cutting Treatment Total (Forested Acres)	**13,340 (13,050)**	**24%**
Forested Acres – No Cutting Treatment	**42,250**	**(76%)**
Total Forested Acres	**55,300**	**(100%)**

*Savanna and meadow restoration treatments are in areas that do not meet the definition of forested.

Logging systems to be used to accomplish tree harvest within the Alternative 3 proposed harvest units and the associated acres are listed in Table V/D_24. Specific design features and best management practices for each logging system are listed in Appendix J.

Table V/D_24. Alternative 3 Acres by Logging System

Logging System	Approximate Acres	Percent of Total Harvest Treatment Acres
Ground Based (Tractor)	4,700	46%

Logging System	Approximate Acres	Percent of Total Harvest Treatment Acres
Line	3,600	35%
Helicopter	2,000	19%
Total Harvest Acres:	10,300	100%

Forest Cover Type

Cover type percent by potential vegetation group and percent change from existing due to alternative 3 treatments are listed in table V/D_25. The prevalent effect in terms of movement toward RV would be in the ponderosa pine cover type. There would be a seven percent increase in the dry PVG and another 1 percent increase in the moist PVG. There would also be notable changes to the Douglas-fir cover type with a six percent reduction in the dry PVG and a 1 percent reduction in the moist PVG. Overall, alternative 3 would move all cover types in both PVGs closer to RV with the exception of lodgepole pine in the moist PVG.

Table V/D_25. Alternative 3 – Post treatment distribution of forest cover types in the Lower Joseph Creek Restoration Project area

Potential Vegetation Group	Cover Type	Acres	Percentage of Potential Vegetation Group (Percent Change from Existing)	Range of variation (%) (Powell 2010)
Dry upland forest (UF)	Ponderosa pine	14,700	35% (+7)	50-80
	Douglas-fir	19,200	45% (-6)	5-20
	Western larch	610	1% (+<1)	1-10
	Lodgepole pine	200	<1% (-<1)	0
	Grand fir	7,300	17% (-1)	1-10
	Engelmann spruce	0	0%	0
	Unknown	260	1%	
Dry UF Total		**42,300**	**100%**	
Moist upland forest (UF)	Ponderosa pine	1,600	12% (+1)	5-15
	Douglas-fir	5,700	44% (-1)	15-30
	Western larch	730	6% (+2)	10-30
	Lodgepole pine	180	1% (-<1)	25-45
	Grand fir	4,600	36% (-<1)	15-30
	Engelmann spruce	90	1% (-<1)	1-10
	Unknown	40	<1%	
Moist UF Total		**13,000**	**100%**	
Grand Total		**55,300**		

Forest Structural Stages

Table V/D_26 summarizes the forest structural stage percent by potential vegetation group and percent change from existing due to alternative 3 treatments. Highest movement toward RV would be in the OFSS structural stage with a five percent increase in the dry PVG and 2 percent increase in moist. The SE stage would experience movement away from RV in both PVGs. Overall, alternative 3 would result in a similar pattern in relation to RV as compared to alternative 2 at slightly lesser amount due to less acres treated.

Table V/D_26. Alternative 3 – Post treatment distribution of forest structural stages in the Lower Joseph Creek Restoration Project area

<table>
<tr><th>Potential Vegetation Group</th><th>Structural Stage</th><th colspan="2">Acres</th><th colspan="2">Percentage of Potential Vegetation Group (Percent Change from Existing)</th><th>Range of variation (%) (Powell 2010)</th></tr>
<tr><td rowspan="7">Dry UF</td><td>OFSS</td><td colspan="2">2,000</td><td colspan="2">5% (+5)</td><td>40-60</td></tr>
<tr><td>OFMS</td><td colspan="2">8,300</td><td colspan="2">20% (-<1)</td><td>5-15</td></tr>
<tr><td>YFMS</td><td>3,000</td><td rowspan="2">19,000</td><td>7% (-1)</td><td rowspan="2">45% (0)</td><td rowspan="2">5-10</td></tr>
<tr><td>UR</td><td>16,200</td><td>38% (+1)</td></tr>
<tr><td>SE</td><td colspan="2">5,700</td><td colspan="2">13% (-5)</td><td>10-20</td></tr>
<tr><td>SI</td><td colspan="2">7,100</td><td colspan="2">17% (+<1)</td><td>15-25</td></tr>
<tr><td>Unknown</td><td colspan="2">180</td><td colspan="2"><1%</td><td></td></tr>
<tr><td colspan="2">Dry UF Total</td><td colspan="2">42,300</td><td colspan="2">100%</td><td></td></tr>
<tr><td rowspan="7">Moist UF</td><td>OFSS</td><td colspan="2">210</td><td colspan="2">2% (+2)</td><td>10-20</td></tr>
<tr><td>OFMS</td><td colspan="2">4,200</td><td colspan="2">32% (+2)</td><td>15-20</td></tr>
<tr><td>YFMS</td><td>1,800</td><td rowspan="2">4,500</td><td>14% (-1)</td><td rowspan="2">35% (-1)</td><td rowspan="2">10-20</td></tr>
<tr><td>UR</td><td>2,700</td><td>21% (+1)</td></tr>
<tr><td>SE</td><td colspan="2">1,900</td><td colspan="2">15% (-3)</td><td>20-30</td></tr>
<tr><td>SI</td><td colspan="2">2,100</td><td colspan="2">16% (+<1)</td><td>20-30</td></tr>
<tr><td>Unknown</td><td colspan="2">20</td><td colspan="2"><1%</td><td></td></tr>
<tr><td colspan="2">Moist UF Total</td><td colspan="2">13,000</td><td colspan="2">100%</td><td></td></tr>
<tr><td>Grand Total</td><td></td><td colspan="2">55,300</td><td colspan="2"></td><td></td></tr>
</table>

Tree Density Class

Table V/D_27 displays the density class percent by potential vegetation group and percent change from existing due to alternative 3 treatments. Overall, alternative 3 would move or maintain all density classes within RV for both PVGs with the exception of dry high, which would remain outside RV.

Table V/D_27. Alternative 3 – Post treatment distribution of tree density classes in the Lower Joseph Creek Restoration Project area

Potential Vegetation Group	Tree Density Class	Acres	Percentage of Potential Vegetation Group (Percent Change from Existing)	Range of variation (%) (Powell 2010)

Dry UF	Dry High	10,100	24% (-9)	5-15
	Dry Mod	10,100	24% (-8)	15-30
	Dry Low	21,900	52% (+18)	40-85
	Unknown	180	<1%	
Dry UF Total		**42,300**	**100%**	
Moist UF	Moist High	3,800	29% (-16)	15-30
	Moist Mod	4,900	37% (+9)	25-60
	Moist Low	4,200	32% (+7)	20-40
	Unknown	50	<1%	
Moist UF Total		**13,000**	**100%**	
Grand Total		**55,300**		

Pattern

Alternative 3 would treat 13,050 acres using the Individuals, Clumps and Openings (ICO) approach to restoring forest spatial pattern.

Size Class Distribution

Similar to alternative 2, thinning treatments would result in an immediate increase in average tree diameter by favoring dominant and codominant trees. The treatments would also increase average tree diameter in the short term by reducing intertree competition and improving individual tree growth.

Table V/D_28 displays the estimated post treatment size class distribution and the percent change from the existing distribution. For both the dry and moist PVGs, tree size class would be trending toward larger tree size classes with a five and six percent increase respectively in the >20 size class.

Table V/D_28. Alternative 3 - Tree size class distribution in the Lower Joseph Creek Restoration Project area

Potential Vegetation Group	Tree Size Class (diameter range in inches)	Acres	Percentage of Potential Vegetation Group (Percent Change from Existing)
Dry upland forest (UF)	<5	6,600	16% (-1)
	5-10	1,300	3% (+1)
	10-15	13,000	31% (-7)
	15-20	12,300	29% (-1)
	>20	8,900	21% (+5)
	Unknown	180	<1%
Dry UF Total		**42,300**	**100%**
Moist upland forest (UF)	<5	1,900	15% (-1)
	5-10	900	7% (+1)
	10-15	2,900	22% (-5)
	15-20	3,500	26% (+2)
	>20	3,700	29% (+6)
	Unknown	70	<1%
Moist UF Total		**13,000**	**100%**
Grand Total		**55,300**	

Disturbance and Fire Regime

The effects of harvest, SI, and prescribed fire are described in “Effects common to all action alternatives”, above. The action alternatives vary in effect based solely on intensity of treatment represented by the number of acres. Alternative 3 includes less acres of harvest and SI thereby improving forest structure, density, and composition and associated fire regime characteristics to a lesser degree than under Alternative 2.

Prescribed Fire (Planned and Unplanned)

Alternative 3 has less area identified as a high priority for prescribed fire (46,500 acres) than Alternative 2 (48,600 acres), primarily due to the relatively lower forest area treated mechanically, and thus needing activity fuels treatment. Alternative 3 has similar beneficial impact on fire regime departure and landscape resiliency by burning approximately 4 to 6 percent of the landscape per year compared to Alternative 2 (modeled results, see Appendic C). Where Alternative 3 departs from Alternative 2 in that benefit occurs during high fire years where approximately 15– 25 percent is predicted to burn. This is outside the reference fire regime and expected natural burn pattern insofar as the area moving toward fire as a natural disturbance process. During high fire years, even with treating approximately 4 to 6 percent/year with prescribed fire, Alternative 3 further departs from reference and desired landscape conditions and is relatively similar to conditions under the no action alternative.

Activity Fuels

There would be less activity fuels created with the implementation of Alternative 3 as compared to Alternative 2. The treatment of activity fuels in “Effects common to all action alternatives” remains the same. Disposition of activity fuels is a key part in ensuring that fire severity does not increase due to the additional accumulation of fuels as a result of silvicultural activity. There is no increased impact to fire risk under Alternative 3 when compared to Alternative 2.

Fire Management Decision Space

Alternative 3 creates limited decision space to manage wildland fire (planned and unplanned ignitions). State-and-transition simulation modeling (Appendix C) indicates that during a high fire year in the LJCRP area the amount of the landscape that burns is departed (greater) than the expected fire regime extent (6-15%/year). Although there is no difference between expected acres intentionally burned with planned and unplanned ignitions, (4 – 6%) depending on the year, there is limited benefit to managing unplanned ignitions under Alternative 3 due to not actively managing IRA, PWA, Designated Old Growth, and RHCAs. This creates an environment similar to the no action in terms of ecological and social risk of having unwanted fire effects such as uncharacteristically severe fire or fire affecting a large portion of the area (particularly within or adjacent to IRA, PWA, Designated Old Growth, and RHCAs) in a given year such as to impact the character of forest succession and fire regime. Alternative 3 has limited effect to areas around and within IRA, PWA, Designated Old Growth, and RHCAs on the ability of wildland fire to become a restorative process at an ecologically appropriate scale and severity without active management in those areas.

Insects and Disease Susceptibility

Table V/D_29 lists the estimated, alternative 3 post treatment susceptibility ratings for the six insect and disease agents associated with the PVGs and cover types within the LJCRP area. The ratings and trends are similar to alternative 2 with the following exceptions.

Dry and Moist PVG

- Douglas fir mistletoe would be outside RV for the low and high ratings and within RV for the moderate rating. The low is the same as existing with the moderate rating higher than existing and the high rating lower than existing.

Table V/D_29. Alternative 3 – Post treatment insect and disease susceptibility in the Lower Joseph Creek Restoration Project area

Potential Vegetation Group	Agent	Susceptibility Rating - % of Forested Area					
		Low		Moderate		High	
		Post Trt.	RV Range	Post Trt.	RV Range	Post Trt.	RV Range
Dry upland forest (UF)	**Defoliators**	29%+	40-85%	40%+	15-30%	31%-	5-15%
	Douglas-fir Beetle	15%=	35-75%	50%+	15-30%	35%-	10-25%
	Fir Engraver	40%=	45-90%	45%=	10-25%	14%=	5-10%
	Bark Beetles in P Pine	22%-	5-10%	58%+	15-30%	19%-	40-90%
	Douglas-fir Dwarf Mistletoe	14%=	25-55%	40%+	15-40%	46%-	20-35%
	Root Diseases	31%=	30-60%	51%+	25-50%	18%-	5-25%
Moist upland forest (UF)	**Defoliators**	9%+	5-10%	28%-	20-30%	62%-	35-90%
	Douglas-fir Beetle	5%=	30-60%	27%+	20-40%	67%-	10-30%
	Fir Engraver	20%+	30-70%	35%+	20-35%	45%-	10-20%
	Bark Beetles in P Pine	30%-	40-70%	61%+	15-35%	10%-	5-25%
	Douglas-fir Dwarf Mistletoe	11%=	30-65%	34%+	20-45%	55%-	10-20%
	Root Diseases	17%+	5-15%	55%+	20-50%	27%-	35-75%

+ increase from current; - decrease from current; = same as current.

Dwarf Mistletoe and the Degree of Mistletoe Infestation - Design criteria common to all treatment types, includes discriminating against mistletoe infected trees, discriminating against host species (Douglas-fir) and creating conditions that minimize potential for spread to uninfected trees. This would result in a reduced mistletoe infection wherever mistletoe infections occur within the 13,340 acres of cutting treatment proposed under alternative 3. This includes 200 acres of cutting treatment in moderate to heavily mistletoe infected stands.

Alternative 3 Other Direct and Indirect Effects:

Yarding and Fuel Treatment

Some damage to the residual trees would be expected with the felling, yarding and piling operations within 10,300 acres of mechanical treatments. Damage would be minimized through contract administration and proper harvest methods. Burning treatments on 46,500 acres of high priority areas would reduce understory stocking and reduce inter-tree competition as well as stimulate understory vegetation (shrubs, forbs, grasses). Fire control lines would use existing features with naturally low fuels, skid trails, roads etc. as much as possible. Actual construction of control lines would remove herbaceous material to bare mineral soil.

Timber Resource

There would be approximately 10,300 acres of harvest treatment (acres treated that remove timber volume) and there would be approximately 6,600,000 cubic feet of timber volume removed as a result of restoration treatments. This is a direct beneficial effect of Alternative 3.

Road Maintenance, Reconstruction, Temporary Road Construction, Closure and Decommissioning

Road maintenance within the existing road prism would have no effect on the health and growth of the leave trees within the treatment units. Reconstructing 82.6 miles of road will remove trees and forest vegetation within the area being reconstructed (approximately 250 acres). Constructing 12.6 miles of temporary roads will remove trees and forest vegetation within the road right of ways (approximately 40 acres). Road closure and decommissioning of 9 miles of roads would allow ingrowth of forest vegetation once the road is decommissioned (approximately 27 acres). Possible management actions associated with above listed activities includes: Reestablish former drainage patterns, stabilizing slopes, and restore vegetation; Block the entrance to a road or installing water bars; Remove culverts, reestablish drainages, remove unstable fills, pull back road shoulders, and scatter slash on the roadbed; Completely eliminate the roadbed by restoring natural contours and slopes; and Other methods designed to meet the specific conditions associated with the unneeded road.

Aquatic Organism Passage

Replacing 6 culverts to improve aquatic organism passage may remove trees and forest vegetation directly within the area of associated construction. The area affected adjacent to each culvert is approximately .5 acre for a total of 3 acres.

Hazard Tree Falling

The cutting and removal of hazard trees in association with Alternative 3 harvest operations and road work may reduce old trees and large trees adjacent to these activities. The limited number of hazard trees is not expected to have an overall effect on cover type, forest structure, density class or size class distribution.

Cumulative Effects

For the cumulative effects analysis, the spatial context being considered is the 98,600 acre project area. Cumulative effects are discussed in terms of wildfire and vegetation management activities that have occurred since 2004 and as changes in the existing condition due to present and foreseeable activities, including the effects of the alternative being discussed. The time frame considered is approximately 10 years in the future at which time the majority of the actions proposed will have been completed and the vegetation response to these actions has occurred.

Vegetation Management Activities and Wildfire 2004 to 2013

Table V/D_30 lists approximate acres of the various vegetation management, fuels treatment and prescribed burning activities as well as wildfires that have occurred within the project area from 2004 to 2013.

Cultural vegetation activities that have occurred in the project area over the last ten years includes 160 acres of tree planting after harvest and 830 acres of precommercial thinning within young, post disturbance stands. Mechanical vegetation management activities have mainly consisted of tree thinning. This includes 1,300 acres with an emphasis on improving forest structure, health and growth and 120 acres of uneven-aged management thinning of all age classes and establishment of a new cohort.

Fuels treatments that have been accomplished in association with mechanical treatments included 180 acres of thinning for hazardous fuels reduction, as well 590 acres of treatments with a primary focus of rearrange and reduce activities generated fuels (slash lopping, crushing, piling and jackpot burning) and 640 acres of pile burning.

Prescribed burns have been implemented on 870 acres to improve wildlife habitat, reduce natural fuels accumulations and reintroduce fire to fire adapted ecosystems.

Wildfires from 2004 to 2013 have burned on approximately 23,800 acres of the project area. These fires all burned within the same vicinity on the eastside of the project area and have substantial overlap between them. Of the acres burned, it is estimated that the overall average burn severity to the forested vegetation was 20 percent high severity, 60 percent mixed severity and 20 percent low severity. There is wide variability among these percentages from fire to fire due to these fires burning the same area multiple times.

Table V/D_30. 2004 to 2013 – Approximate acres of vegetation management activities and wildfire in the Lower Joseph Creek Restoration Project area

Treatment	Treatment Type	Approximate Acres
Cultural	Tree Planting	160
	Precommercial Thin	830
Total Cultural:		**990**
Mechanical Vegetation Management	Commercial Thin	1,300
	Single-tree Selection Cut (UA/RH/FH)	40
	Group Selection Cut (UA/RH/FH)	80
	Sanitation Cut	10
Total Mechanical:		**1,400**
Fuels Treatments	Thinning for Hazardous Fuels Reduction	180
	Yarding - Removal of Fuels by Carrying or Dragging	90
	Piling of Fuels, Hand or Machine	460
	Rearrangement of Fuels	40
	Burning of Piled Material	640
Total Fuels Treatments:		**1,400**
Prescribed Burn	Broadcast Burn (Majority of Unit) - Wildlife Habitat	590
	Underburn (Majority of Unit) - Low Intensity	280
Total Prescribed Burn:		**870**
Wildfire	Jim Creek - 2006	360
	Cottonwood - 2007	8,400
	Cache Creek - 2012	15,00
Total Wildfire:		**23,800**

The following is a discussion of effects of these past management activities and wildfires in terms of the analysis metics specific to the vegetation resource.

Forest Cover Type – Planting activities increased occurrence of ponderosa pine and western larch within understocked areas. Thinning treatments favored ponderosa pine and western larch and discriminated against grand fir. Prescribed burning and wildfires also favored fire resistant tree species.

Forest Structural Stages - Thinning treatments generally retained old and large trees. Sanitation treatments may have removed some old forest structure. Prescribed burning and low severity wildfire resulted in periodic tree mortality of susceptible old trees. Mixed and high severity wildfire killed a large proportion of the old forest structure and increased acres within the stand initiation structural stage.

Tree Density Class - Thinning treatments resulted in forest density within the low to moderate density classes. This in turn had a beneficial effect of improved forest growth. Prescribed fire and low severity wildfire also led to localized reduction of forest density.

Pattern - The thinning treatments resulted in some irregular tree spacing. These treatments were incidental to reestablishing forest openings and attaining a mosaic of interspaces and tree clumps of varying sized and shapes. Mixed severity wildfires resulted in a mosaic of tree mortality and a pattern with indiscriminate interspaces and tree clumps. The remaining treatments and low severity wildfire resulted in some irregular tree spacing and clumping.

Size Class Distribution – Thinning treatments, prescribed fire and low severity wildfire generally favored larger trees and removed trees in the smaller size classes. This resulted in a size class distribution emphasis toward larger tree size classes. Moderate and high severity wildfire removed trees among all size classes.

Insects and Disease – Susceptibility was reduced in the thinning and prescribed burning treatments and low severity wildfire by enhancing stand conditions that are conducive to improved forest health (trending toward RV). Thinning treatments also removed dwarf mistletoe infected trees reducing the percent of trees infected as well as creating conditions that slowed or inhibited mistletoe spread. Prescribed fire and low severity wildfire also led to localized reduction of forest density and dwarf mistletoe infection.

Cumulative Effects – Alternative 1

Vegetation

Alternative 1 would not contribute to moving forest composition, structure, density toward desired conditions or enhancing forest pattern or size class distribution or improving trends in insect and disease susceptibility.

Disturbance and Fire Severity

Past harvest, fuel treatment, fire suppression, and livestock grazing have shaped the current stand conditions and altered disturbance processes across the LJCRP area. Fire suppression and livestock grazing would continue to alter the disturbance processes and in general would increase the severity of those disturbances. The landscape would potentially lose the large, early seral, old trees on the landscape to fire or insect mortality as the forested stands would continue to increase density and favor late-seral species at the expense of early seral (ponderosa pine and larch) tree species regeneration. There is the potential to alter seed source availability and seed bed viability under this Alternative.

With the exception of the effects of fire suppression on increased forest and shrub densities, the no action alternative would not contribute to the cumulative effects of past and present activities. Past timber management activities including regeneration harvest, commercial thinning, precommercial thinning and salvage have resulted in fewer mature and old growth stands, with fewer large trees and large snags. These activities have favored wildlife and plant species (e.g., some Neotropical migratory bird species) that prefer early-seral stand conditions. Recreation, wood cutting, and roads would continue to lead to a reduction in snag habitat for species dependent on these habitat components in some areas.

Cumulative Effects – Alternatives 2

Vegetation

Alternative 2 restoration treatments would contribute an additional 22,000 acres toward moving forest composition, structure, density toward desired conditions or enhancing forest pattern or size class distribution or improving trends in insect and disease susceptibility.

Disturbance and Fire Regime

Past harvest, fuels treatment, prescribed fire and wildfire have influenced the character of the natural fire regimes found in LJCRP. In general each of these activities helped shape the affected environment and existing conditions for this project area, along with past grazing and fire suppression. In general the cumulative effect of past harvest (assuming that it was not overstory removal of early seral species) have served to promote restoration objectives by predominantly reducing density and associated mortality effects. In some cases group selection was used as a harvest method which would facilitate the ability of early seral regeneration. Fuels treatments and prescribed fire are targeted to reduce the probability of high severity fire and restore natural disturbance regimes. Wildfire is generally of higher severity than the natural regimes, except for the case of non-forest areas within the project, therefore wildfires influence often further departs from the range of variability of forest structure, density, and composition by simplifying at multiple scales (landscape and stand).

The treatments proposed in the LJCRP in conjunction with past beneficial and past adverse treatments would promote the re-introduction of fire at a natural and ecologically appropriate scale and severity.

Fire Management Decision Space

Past management actions and wildfires cumulatively affect fire managers' ability to confidently return fire as an ecological process. Utilizing areas of reduced fire behavior, typically identified by past treatment and wildfire, can often decrease the risk (safety, social and ecological) of allowing an unplanned ignition to perform an ecologically important role and restore a natural disturbance regime. These past actions alongside treatments identified in Alternative 2 would facilitate the increased acceptance of characteristic wildland fire and its ecological role in restoring disturbance processes in the LJCRP area.

Cumulative Effects – Alternatives 3

Vegetation

Alternative 3 restoration treatments would contribute an additional 12,500 acres toward moving forest composition, structure, density toward desired conditions or enhancing forest pattern or size class distribution or improving trends in insect and disease susceptibility.

Disturbance and Fire Regime

Past harvest, fuels treatment, prescribed fire and wildfire have influenced the character of the natural fire regimes found in LJCRP depending on their objectives and outcomes. In general each of these activities helped shape the affected environment and existing conditions for this project area, along with past grazing and fire suppression. In general the cumulative effect of past harvest (assuming that it was not overstory removal of early seral species) have served to promote restoration objectives by predominantly reducing density and associated mortality effects. In some cases group selection was used as a harvest method which would facilitate the ability of early seral regeneration. Fuels treatments and prescribed fire are targeted to reduce the probability of high severity fire and restore natural disturbance regimes. Wildfire is generally of higher severity than the natural regimes, except for the case of non-forest areas within the project, therefore wildfires influence often further departs from the range of variability of forest structure, density, and composition by simplifying at multiple scales (landscape and stand).

The treatments proposed in the LJCRP in conjunction with past beneficial even with past adverse treatments would promote the re-introduction of fire at a natural and ecologically appropriate scale and severity.

Fire Management Decision Space

Past management actions and wildfires cumulatively affect fire managements' ability to confidently return fire as an ecological process. Utilizing areas of reduced fire behavior, typically identified by past treatment and wildfire, can often decrease the risk (safety, social and ecological) of allowing an unplanned ignition to perform an ecologically important role and restore a natural disturbance regime. These past actions alongside treatments identified in Alternative 3 would facilitate somewhat limited acceptance of characteristic wildland fire and its ecological role in restoring disturbance processes in the LJCRP area. This is due in part to the large areas of untreated and ecologically important land that would continue to depart from historic disturbance severity and behavior. Adverse effects to these areas may not be socially or ecologically desirable given the expected effects of wildfire therefore the decision space is narrowed when fire occurs within or around these specific areas.

Cumulative Effects – Present and Foreseeable Vegetation Management Activities

There are no vegetation management, fuels treatment and prescribed burning activities that are ongoing (as of 2014) or are foreseeable within the project area.

Climate change and Air Quality

Introduction

Resource Indicators and Measures

Relative comparisons of the degree of climate change adaptation between alternatives are based on evaluation of one or more of the following indicators:

• Acres available for planting (even-aged harvest) and providing opportunities to adapt tree species composition to changing climates

• Acres of designated wildlife corridors, which can reduce barriers to movement

• Acres of thinning to restore disturbance regimes and/or reduce uncharacteristically severe wildland fires

• Miles of roads with improved drainage and reduced sediment delivery, thus reducing hydrologic connectivity of the road system

• Miles of riparian restoration, which restores floodplain connectivity, flow regimes, and/or increases effective stream shade

• Acres of invasive plants treated

Affected Environment

Climate

Climate across the project area and the greater Blue Mountains is changing, and these changes will influence local ecosystems and their role in human communities. Average annual temperatures in the Pacific Northwest have risen by 1.5 °F since 1900. Since 1950, temperatures have risen at twice the rate of increase that occurred before 1950 (Mote 2003a). Temperatures are expected to increase by 0.2 to 1 °F per decade throughout the 21st century.

Based on average data for Blue Mountains (Oregon climate zone 8), average precipitation is lower since 1970 for every month except April, July, and August. Cool season (October through March) precipitation is lower by 14 percent; warm season precipitation (April through September) is lower by 2 percent; July and August precipitation is higher by 27 percent.

Decline in April 1 snowpack - all but 2 of 34 measuring stations have recorded declines in April 1 snowpack since 1970, with an average decline of 24 percent and a range of 5 to minus-73 percent (Gecy 2010). Snowpack declines are expected to continue across the Blue Mountains as temperatures throughout the region increase. Continued warming is expected to result in more winter precipitation falling as rain rather than snow and less winter snow accumulation.

The projected increase in air temperatures and the resulting effect on snow pack and timing and magnitude of rainfall is predicted to have considerable impact on natural resources and their management in the region and in the Blue Mountains. Climate-informed modeling completed for the Blue Mountains by the USFS PNW Research and Development program (Kerns et al. unpublished data) showed a strong conversion of forested lands to arid lands in the next 9 decades (Appendix C). In most cases (three of four climate models), the landscape becomes dominated by big sagebrush communities, often with exotic grasses.

Recent drought susceptibility modeling has developed maps highlighting the most at risk areas of drought that can help identify increased risk for disrupted disturbance processes with increased severity. The current trends in climate change will lead to prolonging the late season drought, and increasing fire season length, and the size of annual area burned, leading to increased occurrence of fire potential (McKenzie et al. 2004, Westerling et al. 2006, Cansler and McKenzie 2014). This, coupled with fire suppression policies could, lead to larger more severe and uncharacteristic fires, most obvious in the moisture-limited and dryer moist upland forest plant associations. Drought, along with other biophysical factors, also influences susceptibility and vulnerability to insect and disease disturbances (Hessburg et al. 1999, Lehmkuhl et al. 1994, Schmitt and Powell 2005).

Increasing air temperatures, decline in snowpack and changes in the magnitude and timing of rainfall are expected to reduce summer streamflow, increase cool season streamflow, and increase stream temperatures at least during the next century throughout the Pacific Northwest. These changes in streamflow and temperature have the potential to directly impact aquatic habitat and organisms. Climate change may affect water storage and seasonal water availability in climate change scenarios that reflect a warming climate (Mantua 2010). Snow pack will decrease in these scenarios, thus reducing the intensity of peak flows.

The Droughty Soils Index analysis, conducted by Oregon State University (2014), predicts the susceptibility of soils within the LJCRP analysis area (Map 4). Their results indicate that soils within the proposed treatment area are particularly susceptible to a warming climate. Moving the landscape to a more resilient species composition and structure, described in the Desired Conditions, would help respond to predicted climate change scenarios. Moving the vegetation towards the historic range of variation and creating a more fire resilient landscape would mitigate some of the effects of a seasonal reduction in water storage.

Ecosystems are affected not only by climate change but also through carbon sequestration (e.g., plant growth) and greenhouse gas emissions (e.g., fire, organic matter decomposition, and soil respiration). Ecosystem functions also directly influence the global carbon cycle.

Forest management can offset greenhouse gas emissions by increasing capacity for carbon uptake and storage in biomass, wood products, and soils. Forests of the Blue Mountains currently store substantial carbon stocks. Forest management activities and disturbances, such as wildland fire, can either increase or reduce carbon stocks over time, depending on their type, frequency, and severity. Management activities carried out in response to climate change, such as thinning of forests to reduce risk of stand replacing wildland fire or insects disturbances, or to reduce moisture stress on the remaining trees, may reduce carbon stocks in the short term, but can have long-term benefits for carbon sequestration (Zhang et al. 2010). In general, current Forest Service management activities are unlikely to affect forest carbon stocks substantially in the Blue Mountains.

The most cost-effective climate change mitigation strategies (i.e., reducing carbon emissions) in forestry are sustainable forest management (i.e., reducing forest fires) and afforestation, reducing deforestation, and producing a sustained yield of timber, wood fiber, or energy (IPCC 2014). None of the alternatives analyzed in this EIS cause deforestation. Uncharacteristic fire disturbance can result in carbon lost to the atmosphere in the short-term. If this disturbance interacts with climate changes that cause shifts in vegetation from forests to other vegetation types with less carbon sequestration potential, it can contribute to lower carbon sequestration over the longer-term. The strategic goals of the 2010–2015 USDA strategic plan (USDA 2010) include that national forests and private working lands are conserved, restored, and made more resilient to climate change, including mitigation considerations. Carbon density of forests on the Wallowa-Whitman National Forest are relatively moderate (180-240 Mg C/ha) compared to westside forests (over 300 Mg C/ha; Heath et al. 2011).

Air Quality

The Clean Air Act requires that the Environmental Protection Agency (EPA) establish standards for certain pollutants in order to protect human health and welfare. National Ambient Air Quality Standards (NAAQS) have been established (Table C/A_1). Particulate matter is the primary pollutant of concern in smoke management. Particulate matter less than 2.5 microns in diameter (PM2.5) or less than 10 microns in diameter (PM10) describes particles small enough to enter the human respiratory system.

Table C/A_1 describes the NAAQS levels described in terms of PM10 and 2.5.

Pollutant	Averaging Period	Primary NAAQS
PM 10	Annual arithmetic mean	n/a
	24-hour	150 µg/m^3
PM 2.5	Annual arithmetic mean	15 µg/m3
	24-hour	35 µg/m3

Air quality monitoring sites are located in LaGrande, Cove, and Baker City, Oregon. These sites maintain equipment that provides estimates for PM10 and PM2.5 levels for health purposes. Visual quality is monitored from an automated IMPROVE (Integrated Monitoring for Protected Visual Environments) site located within Starkey Experimental Forest.

Smoke generated from wildfire would continue to increase as the landscape further departs from reference conditions and fuel loadings increase and become more continuous across the LJCRP area. There are two areas of concern due to smoke impacts: the town of Enterprise, Oregon which is an identified smoke sensitive receptor area and the Eagle Cap Wilderness which is identified as a Class 1 Airshed.

Local research indicates that PM10 production due to wildfire is approximately twice that produced in a prescribed fire (Huff 1995).

All burning would be conducted in compliance with Oregon DEQ requirements and applicable agreements. Burns will be registered, planned, accomplishment reported, and monitoring conducted as specified in the Oregon Smoke Management Plan (OAR 629-048, 2008). Burn plans will address smoke management concerns and requirements.

Management Direction

Climate change adaptation

All action alternatives include management actions that would improve the ability of National Forest resources to adapt to a changing climate. The alternatives vary in the types and amount of actions. Activities for addressing climate change include the following:

- Conserving species and habitats threatened directly or indirectly by climate change, enhancing landscape connectivity, and reducing barriers to species movement to facilitate the ability of species to move across the landscape with shifts in habitat distributions
- Reducing the risk of uncharacteristically severe fires and insects and disease disturbances through forest thinning
- Reducing the risk of increased nonnative species infestations through reductions in the extent of current nonnative species and prevention of future infestations
- Reducing potential increases in stream temperatures through riparian buffers, stream restoration, and development and maintenance of effective stream shade
- Reducing risk of water quality degradation while increasing aquatic connectivity by decreasing road density, reducing hydrological connectivity of the road system, replacing culverts, and road closure, realignment or decommissioning

Air Quality

Forest management activities, particularly timber slash burning, can contribute significantly to short-term air quality problems. Adverse effects, however, can often be adjusted by avoiding periods of poor smoke dispersal.

The Forest lies in the Eastern Oregon Intrastate Air Quality Region, the Idaho Intrastate Air Quality Region (No. 62) and the Eastern Washington-Northern Idaho interstate Air Quality Region (No 63). In accordance with the Clean Air Act (P.L. 88-206) as amended, these regions are classified according to the amount of air degradation that could be permitted. The Eastern Oregon Air Quality Region has been classified Priority 2 (moderate degradation permitted) for suspended particulates and Priority 3 (fairly heavy degradation permitted) for other pollutants. The two Idaho regions are classed as Priority 1 (virtually no degradation permitted) for particulates.

Forest plan direction specific to air quality –

- Meet applicable Air Quality guidelines to meet the Clean Air Act requirements as administered by the state of Oregon: National forest air quality and emissions produced from forest activities complies with state ambient air quality standards (Oregon, Idaho, and Washington) and federal air quality and smoke management plans. (desired condition 1.9)

Environmental Consequences

Direct, Indirect, and Cumulative Effects - Alternative 1 (No Action)

Climate

No management activities would be implemented under alternative 1; hence, no improvement in climate change adaptation would occur.

Climate-informed modeling completed for the Blue Mountains by the USFS PNW Research and Development program (Kerns et al. unpublished data) suggest that Alternative 1 allows a bit more conversion of forest land to arid lands than Alternatives 2 and 3, presumably because of the potential for uncharacteristic stand replacement disturbances in catalyzing conversion. Modeling also showed that Alternative 1, under the best case climate model (MIROC; Appendix C), would result in considerably less large tree forests than Alternatives 2 and 3, which increase forest resilience to climate change. However, very little large tree forests remain after 90 years under the three other climate models studied.

Alternative 1 would result in no improvement in the extent of uncharacteristic fire disturbance. Uncharacteristic fire disturbance can result in carbon lost to the atmosphere in the short-term. If this disturbance interacts with climate changes that cause shifts in vegetation from forests to other vegetation types with less carbon sequestration potential, it can contribute to lower carbon sequestration over the longer-term. The strategic goals of the 2010–2015 USDA strategic plan (USDA 2010) include that national forests and private working lands are conserved, restored, and made more resilient to climate change, including mitigation considerations. Carbon density of forests on the Wallowa-Whitman National Forest are relatively moderate (180-240 Mg C/ha) compared to westside forests (over 300 Mg C/ha; Heath et al. 2011). In general, due to the scale of the LJCRP, and the relatively moderate current carbon density of eastside forests, Alternative 1 is unlikely to affect forest carbon stocks substantially in the LJCRP or analysis area over the next 10-15 years.

Air

There would be no direct effects to air quality under Alternative 1.

In the absence of harvest, SI, and prescribed fire, forest vegetation and fuel loading would continue to depart from reference conditions and associated disturbance would continue to operate outside characteristic severity levels. Seasonal wildfire would continue to occur with the potential to become larger and more severe. Large fires have the potential to produce more smoke than prescribed fire in a shorter time period. The presence of smoke has the potential to impact air quality visibility, communities, and human health. The duration of smoke impacts from wildfire could last from days to months depending on the fuels affected and duration of active fire and would likely be have greater effect than from prescribed burning.

There are no cumulative effects to air quality if Alternative 1 is selected as there are no activities would overlap and no direct or indirect effects would occur.

Direct and Indirect Effects Common to All Action Alternatives

Air Quality

Prescribed burning of forest fuels (logging slash or natural) will comply with Oregon Administrative Rules (OAR) 629-048-0001 to 629-048-0500 (Smoke Management Rules) within any forest protection district as described in OAR 629-048-0500 to 0575. These rules establish emission limits for the size of particulate matter (PM10/PM2.5) that may be released during these activities.

Huff (1995) found PM 10 smoke production was twice as high for wildfires as for prescribed fire because wildfires generally occur during drought periods in which there are low fuel moistures and more fuel available for consumption. Their research in the Grande Ronde Basin found the following levels of PM10 emissions (Table C/A_2). This study did not look at PM 2.5 as a subset of PM 10 but smoke production models used to submit burn plans to the State of Oregon at the time of implementation will show the respective levels. Past experience with this modeling has shown a similar trend in the level of PM 2.5.

Table C/A_2. PM10 emissions in the Grande Ronde Basin for prescribed fire and wildfire

Fire Type	PM 10 (tons/acre)
Wildfire	0.318
Prescribed Fire	0.167

Under both action alternatives up to 90,000 acres are available to manage with fire thus air quality and smoke emissions would be similar and would follow the established rules to comply with the Clean Air Act prior to implementing planned ignition or using unplanned ignitions to benefit restoration objectives. The number of acres accomplished per year would be determined by established emission limits negotiated with the State of Oregon, funding, appropriate burn conditions, and personnel availability. Over the past decade the Wallowa Mountains Office has accomplished approximately 3,500 acres of prescribed fire annually with existing personnel during appropriate burn windows to meet prescription parameters. It is reasonable to expect a similar level of annual accomplishment.

Climate Change

All action alternatives include management actions that would improve the ability of national forest resources to adapt to a changing climate. The alternatives vary in the types and amount of actions. Activities for addressing climate change include the following:

- Conserving species and habitats threatened directly or indirectly by climate change, enhancing landscape connectivity, and reducing barriers to species movement to facilitate the ability of species to move across the landscape with shifts in habitat distributions
- Reducing the risk of uncharacteristically severe fires and insects and disease disturbances through forest thinning
- Reducing the risk of increased nonnative species infestations through reductions in the extent of current nonnative species and prevention of future infestations

- Reducing potential increases in stream temperatures through riparian buffers and stream restoration and maintenance of effective stream shade
- Reducing risk of water quality degradation while increasing aquatic connectivity by decreasing road density, reducing hydrological connectivity of the road system, replacing culverts, and road closure, realignment or decommissioning

Cumulative Effects Common to All Alternatives

Climate Change

Climate change effects are a component of cumulative impacts. Changes in climate influence vegetation, water, and disturbance frequencies; and these changes, in turn, influence one another. A change in one aspect causes a cascade of responses that, in some cases, counteract and, in others, magnify the initial change. Such interactions make prediction of the likely effects of climate change difficult at the scale of the LJCRP analysis area even if the nature of the climate change were known. For now, it is certain that changes will occur at a continental scale; however, how climate change impacts local landscapes is not well understood.

Climate-informed modeling completed for the Blue Mountains by the USFS PNW Research and Development program (Kerns et al. unpublished data) suggest that Alternatives 2 and 3 generate considerably more large tree forest than Alternative 1 under the best case climate model (MIROC; Appendix C), but very little large tree forests remain after 90 years under the three other climate models studied.

However, until the environmental responses are better understood, it will be difficult to predict with accuracy the environmental outcomes of particular land-use activities. Species most at risk of climate change are those with small geographic ranges (e.g., local endemics), narrow physiological tolerances, limited dispersal abilities, narrow habitat associations, strong interspecific dependencies, low genetic diversity, and those that have recently experienced population declines. Impacts of climate-related extremes, such as heat waves, droughts, and wildfires, reveal substantial exposure and vulnerability of some ecosystems to climate variability (IPCC 2014). Tools to predict the potential climatic changes as influenced by the LJCRP activities over the next 10 to 15 years have yet to be devised, but it seems unlikely that measurable changes would occur relative to this project (potential temperature and precipitation increases being the most likely climatic change in this part of the continent) over the short life of this planning document (Yates, 2012).

The action alternatives would serve to similarly maintain carbon stocks by reducing uncharacteristic fire disturbance and producing wood products, which serve to sequester carbon. In general, due to the scale of the LJCRP, and the relatively moderate current carbon density of eastside forests (see Affected Environment, Chapter 2), activities of the action alternatives are unlikely to affect forest carbon density appreciably in the LJCRP or analysis area.

Changes in the timing of streamflow reduce water supplies for competing demands. Increasing wildfire, insect outbreaks, and tree diseases are already causing widespread tree die-off (National Climate Assessment, 2014). All climate scenarios run for LJCRP show a landscape becomes dominated by mountain big sage, and warm-season shrubland. Grasslands nearly disappear. Without active management, conifer forest of all types decline to less than 10%, although one model shows Ponderosa pine as a co-dominant with shrublands. Modeling shows that thinning and prescribed fire will conserve forests to mid-century (Hemstrom 2014). Given the dry conditions predicted in the project area, an increase in non-native annual grasses is likely. However, vegetation adapts to changing climate in various ways. Individual plants adjust to climatic changes through phenotypic plasticity via traits like growth phenology and biomass allocation. Populations adapt through natural selection of traits based on genetic variability within the population and through long distance pollen or seed dispersal. Species also adapt to changing climate through migration, resulting in establishment of new populations in favorable habitats and the extirpation of populations from unfavorable habitats (Peterson, et al 2014). In a study of modeled response to climate change for rare plants in California, 60 of 156 species were predicted to have declines in climatic suitability, regardless of modeling technique; however, species in topographically dissected landscapes may be less vulnerable to climate change because they can find suitable climates locally as climate changes (Anacker, et al, 2013). Given the complex topography in LJCRP, perhaps the majority of understory species will be able to persist on the landscape, though at a reduced scale.

Global climate change has the potential to have impacts to aquatic habitat through increases in water temperature and changes in streamflows in response to changes in climates[2]. Long-term changes to aquatic habitat in the analysis area may occur as a result of global climate. These changes may include:

- Increases in water temperatures in response to increases in air temperature,
- Changes in runoff patterns in response to an increase in the amount of winter precipitation that falls as rain:
- Decreases in summer streamflows in response to a reduction in snowpack.
- Reduced duration of spring runoff but higher peak flows due to an increase the amount of winter precipitation that falls as rain

Activities proposed under Alternatives 2 and 3 are unlikely to have measureable cumulative effects with global climate change because:

- The proposed thinning activities are unlikely to result in a change in runoff patterns because a significant decrease in forested cover would not occur.
- Potential increases in water temperature as a result of proposed burning are unlikely to occur in the analysis area and if increases do occur they are unlikely to be measureable.

Air Quality

Past harvest, fuels treatments, prescribed fire and wildfire has occurred over the past 10 years. These past treatments generally reduced forest fuel loading and altered their characteristics such that wildland fire would behave more similar to what would be expected under a natural fire regime. The cumulative effects of these past treatments would serve to reduce the amount of particulates released into the atmosphere. Ongoing activities such as cattle grazing and fire suppression alter the natural disturbance regime allowing increased fuel accumulation (fire suppression and grazing) or a re-arrangement of fuels such that the area burned would be different than historical (grazing).

Air resources are somewhat unique in that past impacts to air quality (past wildland fire or prescribed burns) are usually not evident. Smoke emissions during the spring and fall months primarily result from Federal prescribed fire activities in northeast Oregon and western Idaho. Federal land managers currently coordinate to manage the cumulative effects of prescribed burning across these ownerships. Private landowners also treat fuels on their property and activities are coordinated with Oregon Department of Forestry subject to the Department's smoke management rules.

Other sources of emissions come from summer wildfire, agricultural burning, and home heating around local communities. Wildfires and agricultural burning typically coincide in mid to late-summer. Home

[2] For more information developed by the Forest Service to highlight potential impacts to aquatic habitat in the Pacific Northwest, see http://www.fs.fed.us/ccrc/topics/salmon-trout.shtml

heating is normally limited to winter months. These occurrences generally produce small additive emissions and are not expected to impact air quality at the time prescribed fire activities are planned.

Direct, Indirect and Cumulative Effects – Alternatives 2 and 3

Climate

See "Effects common to all action alternatives", above for more information.

Alternative 2 would bring the LJCRP area closer to reference conditions in vegetation and disturbance regime in comparison to the No Action and Alternative 3, creating a more resilient and sustainable condition in the face of climate change.

Treatments in alternative 3 would move the project area closer to the reference condition in vegetation and disturbance regime, creating a more resilient and sustainable condition in the face of climate change when compared to the No Action, but to a lesser degree than alternative 2.

Air

See "Effects common to all action alternatives", above.

Short-term uses/long-term productivity

Short-term effects of tree removal and prescribed burning will reduce inter-tree competition and free up growing space for residual trees and understory vegetation. Under all alternatives, the proposed actions and associated design features would not affect long-term productivity of forest vegetation and timber resources.

No permanent (e.g., irreversible) impairment of site productivity is expected as a result of the proposed silvicultural activities, and the project's design features, management requirements, and best management practices ensure conservation of soil, slope, and other watershed conditions.

Unavoidable adverse effects

There are no unavoidable adverse effects related to forest vegetation and timber resources.

Irreversible/Irretrievable commitments of resources

Under all alternatives, the proposed actions and associated design features would not involve or invoke irreversible and irretrievable commitments of forest vegetation and timber resources.

Alternatives 2 and 3 – Effects of Not Amending the Forest Plans

The following is a description of how the forest plan amendments under this EIS would modify the forest plans standards and guidelines and what the effects to the vegetation resource would be if the amendment did not occur.

- Alternative 2 - Wildlife Standard (The Eastside Screens – Regional Forester's Amendment # 2 for the Wallowa-Whitman Land and Resource Management Plan (forest plan)). The amendment would authorize: a) Some of the large, but young, Douglas-fir, and grand fir trees that are ≥ 21 inches dbh, but less than 150 years in age (at breast height), would be removed from any of the structural stages being treated, except for units classified as the old forest single stratum structural stage (OFSS; this stage is called "single stratum with large trees" in the Screens); b) Thinning treatments would occur in OFSS.
    - If the amendment did not occur: a) Restoration treatments would be limited to a maximum of 21" dbh thereby reducing the ability to restore forest structure and composition toward reference conditions (HRV), particularly to increase the abundance of shade-intolerant tree species (ponderosa pine and western larch), reduce the risk of uncharacteristically severe fire and insect and disease outbreaks, and increase resiliency to natural disturbance and climate change, b) Restoration treatments would not occur in the OFSS structural stage thereby negating the ability ensure maintenance and

persistence of the large tree component into the future (in terms of improved tree vigor and resistence to western pine beetle attack and future wildfire risk or resiliency to climate change); contribute to species composition objectives for the LJCRP; contribute to density objectives for the LJCRP.

• Alternative 3 - - Wildlife Standard (The Eastside Screens – Regional Forester's Amendment # 2 for the Wallowa-Whitman Land and Resource Management Plan (forest plan)). The amendment would authorize: a) Thinning treatments would occur in OFSS.

o If the amendment did not occur: a) Restoration treatments would not occur in the OFSS structural stage thereby negating the ability ensure maintenance and persistence of the large tree component into the future (in terms of improved tree vigor and resistance to western pine beetle attack and future wildfire risk or resiliency to climate change; contribute to species composition objectives for the LJCRP; contribute to density objectives for the LJCRP.

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Appendix A – Silvicultural Design

Range of Treatments

This EIS analyzed the maximum range of treatments. Implementation of the selected alternative would have the ability to adjust treatment types to on the ground conditions following the guidance presented in the treatment decision matrix.

Treatment Decision Matrix

				Density Class		
	PVG	**Composition Type**	**DMR Rating**	**Low**	**Mod**	**High**
Outside MA 15	Any	Persistent PIPO	None/Low	STS_Low	STS_Mod	STS_High
	Any	Persistent Shade Tolerant	None/Low	STS_Low	STS_Low	STS_Mod
	Dry	Any	Mod/High	IT_Low	IT_Mod	IT_High
	Dry	Recent PSME or Recent ABGR	None/Low	STS_Low	STS_Mod or GS_Mod	STS_High or GS_High
	Moist	Any	Mod/High	IT_Low	IT_Low	IT_Mod
	Moist	Recent PSME or Recent ABGR	None/Low	STS_Low	STS_Low or GS_Low	STS_Mod or GS_Mod
	Dry	Non-Conifer	None/Low	Savanna		
MA 15	Any	Persistent PIPO		STS_OG_Low	STS_OG_Low	STS_OG_Mod
	Any	Recent PSME or Recent ABGR		STS_OG_Low	STS_OG_Low	STS_OG_Mod
	Any	Persistent Shade Tolerant		OG_NoTrt		

Design common to all GS, STS, IT and SI Treatments

Retain and release old trees.

- Retain old trees regardless of size or species. These trees are generally over 150 years old.
- Remove young trees within 1 to 2 drip-lines (the line extending vertically from the exterior edge of a tree’s live crown to the ground) of old ponderosa pine, western larch and Douglas fir. Occasional individual large, vigorous trees may be left when they do not interfere with the objective to reduce crown competition and increase growing space adjacent to old trees. (Note: For alternative 2, this can include trees 21”. See other miscellaneous design below.)

Shift tree composition towards fire and drought tolerant species.

- Favor ponderosa pine and western larch as leave trees in all thinning operations.

Restore a mosaic spatial pattern.

- Follow Individual, Clumps and Openings (ICO) approach to quantifying and restoring forest spatial pattern.
  - Leave tree individuals and clumps. Using observed reference condition as guidance for ratio of individuals to clumps and the number of trees per clump (2-20+).
  - Openings - .2 to 2 acres. Sinuous/amorphous shape and 50-100 feet across on average at the widest point. Number and size would vary depending on existing condition and the density class desired condition and would not exceed 15% of unit.
  - Skips – 1/10 to 1 acre no cut areas. Number and size will vary depending on the existence of suitable conditions and would not exceed 20% of the treatment unit.

Reduce stand densities and increase mean diameter.

- Manage tree density for each density class as prescribed by treatment intensity designation using the following stocking chart as guidance. Overall average density would vary within this range depending on observed reference condition and existing old tree density.

Treatment Intensity Designation

		Treatment Intensity:		
	Post Trt↘	High	Moderate	Low
Existing Density:	High	*Low*	*Moderate*	*High*
	Moderate		*Low*	*Moderate*
	Low			*Low*

Stocking Guidelines by PVG/Density Class

PVG/Tree Density Class	SDI	BA Equivalent (Canopy Cover %): ↘	Quadratic Mean Diameter (QMD)							
			8	10	12	14	16	18	20	22
Dry Low	<83	Less Than	41 (<39%)	45 (<40%)	49 (<41%)	52 (<42%)	55 (<43%)	57 (<44%)	60 (<45%)	62 (<45%)
Dry Moderate	83-128	Between	41-64 (39-50%)	45-70 (40-51%)	49-75 (41-52%)	52-80 (42-55%)	55-84 (43-56%)	57-88 (44-56%)	60-92 (45-57%)	62-96 (45-57%)
Dry High	>128	Greater Than	64 (>50%)	70 (>51%)	75 (>52%)	80 (>55%)	84 (>56%)	88 (>56%)	92 (>57%)	96 (>57%)
Moist Low	<165	Less Than	82 (<67%)	90 (<68%)	97 (<69%)	103 (<70%)	109 (<71%)	114 (<71%)	119 (<72%)	123 (<73%)
Moist Moderate	165-248	Between	82-123 (67-81%)	90-135 (68-82%)	97-146 (69-84%)	103-155 (70-85%)	109-163 (71-86%)	114-171 (71-87%)	119-178 (72-88%)	123-185 (73-89%)
Moist High	>248	Greater Than	123 (>81%)	135 (>82%)	146 (>84%)	155 (>85%)	163 (>86%)	171 (>87%)	178 (>88%)	185 (>89%)

- Thin from below removing trees with poor crowns (<35% live crown ratio).
- Retain young (individuals and clumps) replacement trees at a density of 10 to 30 basal area per acre regardless of density class. Young tree leave trees would consist of vigorous (>35% live crown ratio) dominant and co-dominants with occasional (>45% live crown ratio) mid story and understory trees as individuals or as part of clump.
- Retain wildlife trees – live trees with existing cavities and dead tops.

<u>Initiate fire where and when feasible.</u>

- Burn objectives within thinning units are to increase tree canopy base height, reduce litter/duff cover and produce effects that stimulate regeneration and growth of native herbaceous vegetation.
- Prescribed burns are designed to maintain and enhance desired forest structure, tree densities, snag densities, and CWD levels.
- Retain to the extent possible post-treatment skips. Use ignition patterns and techniques to maintain this structure.

<u>Discriminate against dwarf mistletoe infected trees, host species for Douglas-fir mistletoe and create conditions that minimizes potential for spread to uninfected trees.</u>

- Retention of mistletoe infected trees:
  - Old trees regardless of infection level.
  - Young trees with the lowest mistletoe infection rating when needed to meet stocking objective
- Wherever trees infected with mistletoe are left, establish a non-host or unstocked buffer of at least 50' between infected trees and uninfected residuals.

Other Miscellaneous Design

- Trees ≥21 inches DBH Alternative 2 – Grand fir, lodgepole pine and Douglas-fir trees greater than 21 inches DBH that do not meet the definition of old, may be removed in areas outside of marten source habitat with a STS_High or GS treatment type when necessary to
    - Daylight (reduce crown competition and increase growing space) adjacent to ponderosa pine and western larch.
    - Create canopy gaps of appropriate orientation and size to facilitate natural regeneration of ponderosa pine and western larch
    - Reduce grand fir, lodgepole pine and Douglas-fir seed sources adjacent to canopy gaps to minimize regeneration potential of these species.
- Trees ≥21 inches DBH Alternative 3 – No trees greater than 21 inches DBH may be cut.
- Group selection treatments - No regeneration groups will be created within 100 feet of identified category 4 streams.
- Connectivity corridors –
    - Dry forest PVG stands identified as part of a connectivity corridor, maintain an overall stand canopy cover of 40%+. Use estimates of canopy cover by basal area in stocking table for guidance.
    - Moist forest PVG stands identified as part of a connectivity corridor, maintain an overall stand canopy cover of 50%+. Use estimates of canopy cover by basal area in stocking table for guidance.
- Marten habitat – for stands identified as marten habitat (moist, large tree, closed canopy), maintain an overall stand canopy cover of 60%+. Use estimates of canopy cover by basal area in stocking table for guidance.
- Utilize PACFISH buffers for Category 1 and 3 streams. Follow design criteria for Category 4 streams (see Fisheries PDC Summary).
- Activity fuels management – fuels associated with silvicultural treatments would be treated using mastication, removal, pile and burn, cutting and scattering limbs or other means. Residual fuel levels would be commensurate with predicted burn intensity to meet prescribed fire burn objectives.
- Snags, coarse wood – incorporate the largest snags available and disturbance pockets as indicated by snags, deadwood, or decadence into "skips" as described above.
- Manage coarse wood at the following levels where available:
    - Exceptions to where trees may be removed would be made in the case of threats to human health and safety.

Species	**Pieces per Acre**	**Diameter Small End (inches)**	**Piece Length & Total Linear Length**
Ponderosa pine	3-6	12	>6 feet; 20 – 40 feet
Mixed conifer	15-20	12	>6 feet; 100 -140 feet

Other Treatment Specific Design

Group Selection – Low, Moderate and High Intensity Treatments

ICO variable density thinning within all age classes present; ½ to 4 acre group selection to initiate new cohort of seral species (PP/WL)

- Uneven age thinning and group selection would be used to establish openings between individual trees and tree clumps, thin tree clumps, and create regeneration openings.
- Establish ½ to 4 acre regeneration openings within up to 20% of each GS unit to initiate new cohort of ponderosa pine/western larch. Regeneration opening size and shape is dependent on extent of grand fir/Douglas-fir cohort that is being replaced, extent of available ponderosa pine/western larch seed trees, and sunlight requirement of species that is being regenerated.
- Leave old trees and available ponderosa pine and western larch seed trees within regeneration openings.

Single Tree Selection - Low, Moderate and High Intensity Treatments

ICO variable density thinning within all age classes present.

- Uneven age thinning would be used to establish openings between individual trees and tree clumps, and thin tree clumps.

Single Tree Selection Old Growth – Low and Moderate Intensity Treatments

ICO variable density thinning within all age classes present.

- Retain existing old growth characteristics as described in the WW Forest Plan MA15 description and the R6 Interim Old Growth Definition.

Intermediate Treatment - Low, Moderate and High Intensity Treatments

ICO variable density thinning within all age classes present with emphasis on isolating mistletoe infections and creating conditions that reduce intensification of infection.

- Favor non-host species as leave trees.
- Tree clumps/individuals would be managed to improve tree vigor and growth by retaining the best growing dominant and co-dominant trees with the least amount of mistletoe within each clump.
- Isolate mistletoe infected clumps or individuals with a host tree buffer of approximately 50 feet beginning at the last visible sign of infection

Stand Improvement – Seed/Sap and Pole Treatments

ICO variable density thinning within young, post disturbance stands.

- Thinning would be used to establish openings between individual trees and tree clumps, and thin tree clumps.

Savanna Treatment/Meadow Restoration Treatment

Reestablishment of grassland/forest edges and historic grasslands that have conifer encroachment.

- Restore pre-settlement tree density and pattern using pre-settlement evidence as guidance.
- Tree group arrangement, size, and density are a function of existing pre-settlement trees and evidence. Retain old trees and the largest young trees that most closely resemble old trees in size and form as replacement trees

Appendix B – Data dictionary for LoJoVeg_EC_PA_PAEffects layer.

STAND_TAG (Stand Tag)

Stand polygon identifier. From waw_evg_201008.

Ac_Upd (Acre Update)

Acreage updated to resulting polygons when original evg stand polygons were overlaid with treatment unit polygons.

PVG_12 (Potential Vegetation Group)

Reference: *Powell, David C.; Johnson, Charles G., Jr.; Crowe, Elizabeth A.; Wells, Aaron; Swanson, David K. 2007. Potential vegetation hierarchy for the Blue Mountains section of northeastern Oregon, southeastern Washington, and west central Idaho. Gen. Tech. Rep. PNW-GTR-709. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 87 p.*

Source for this attribute: blues_evg.xlsx, plot data collected by Camp II and data verification process using 2012 NAIP aerial imagery.

Most common codes for forested areas are – Dry UF (upland forest) and Moist UF (upland forest).

pag (Plant Association Group)

Reference: *Powell, David C.; Johnson, Charles G., Jr.; Crowe, Elizabeth A.; Wells, Aaron; Swanson, David K. 2007. Potential vegetation hierarchy for the Blue Mountains section of northeastern Oregon, southeastern Washington, and west central Idaho. Gen. Tech. Rep. PNW-GTR-709. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 87 p.*

Source for this attribute: blues_evg.xlsx. Note: this attribute has not been updated to match PVG_12 code.

ForestCove (Forest Cover Type)

Source for this attribute: blues_evg.xlsx, plot data collected by Camp II and data verification process using 2012 NAIP aerial imagery.

Codes include:

Forest Cover Type	Type Codes	Description
Ponderosa Pine	PIPO	Ponderosa pine is the majority species
	mix-PIPO	Mixed forest; ponderosa pine is plurality species
Douglas-fir	PSME	Douglas-fir is the majority species
	mix-PSME	Mixed forest; Douglas-fir is plurality species
Grand Fir	ABGR	Grand fir is the majority species
	mix-ABGR	Mixed forest; grand fir is plurality species
Western Larch	LAOC	Western larch is the majority species
	mix-LAOC	Mixed forest; western larch is plurality species
Lodgepole pine	PICO	Lodgepole pine is the majority species
	mix-PICO	Mixed forest; lodgepole pine is plurality species
Engelmann spruce	PIEN	Engelmann spruce is the majority species
	mix-PIEN	Mixed forest; Engelmann spruce is plurality species
non-conifer		Generally less than 10% conifer canopy cover

Compositio (Composition Type)

Source for this attribute: forest cover type, plot data collected by Camp II and data verification process using 2012 NAIP aerial imagery.

The composition type code is useful in characterizing pre-fire suppression tree species composition and indicate appropriate management actions to reestablish under-represented species.

Composition Type Code	Description
Persistent PIPO (Ponderosa Pine)	Areas that are currently dominated by ponderosa pine and that have a preponderance of pre-fire suppression era age class ponderosa pine trees or tree evidences (stumps).
Recent PSME (Douglas-Fir)	Areas that are currently dominated by post-fire suppression era age class Douglas-fir and that have a preponderance of pre-fire suppression era age class ponderosa pine trees or tree evidences (stumps).
Recent ABGR (Grand Fir)	Areas that are currently dominated by post-fire suppression era age class grand fir and that have a preponderance of pre-fire suppression era age class ponderosa pine trees or tree evidences (stumps).
Persistent Shade Tolerant	Areas that are currently dominated by post-fire suppression era age class shade tolerant species and that have a mix of pre-fire suppression era age class species trees or tree evidences (stumps) of which a high percentage are shade tolerant (grand fir, spruce).

Struct_Upd (Forest Structural Stage)

Source for this attribute: blues_evg.xlsx, plot data collected by Camp II and data verification process using 2012 NAIP aerial imagery.

Structural Stage	Age Classes	Description
SI – Stand Initiation	1	Following a stand-replacing disturbance such as wildfire or tree harvest, growing space is occupied rapidly by vegetation that either survives the disturbance or colonizes the area. Survivors literally survive the disturbance above ground, or initiate new growth from their underground roots or from seeds on the site. Colonizers disperse seed into disturbed areas, the seed germinates, and then new seedlings establish and develop. A single canopy stratum of tree seedlings and saplings is present in this class.
SE – Stem Exclusion	1	In this structure class, trees initially grow fast and quickly occupy all of their growing space, competing strongly for sunlight and moisture. Because trees are tall and reduce light, understory plants (including smaller trees) are shaded and grow more slowly. Species that need sunlight usually die; shrubs and herbs may become dormant. In this class, establishment of new trees is precluded by a lack of sunlight (stem exclusion closed canopy) or by a lack of moisture (stem exclusion open canopy).
UR – Understory Reinitiation	2	As the forest develops, a new age class of trees (cohort) eventually gets established after overstory trees begin to die or because they no longer fully occupy their growing space. Re-growth of understory seedlings and other vegetation then occurs, and trees begin to stratify into vertical layers. This class consists of a low to moderate density overstory with small trees underneath.
YFMS – Young Forest Multi Statum	3+	In this stage of forest development, three or more tree layers have be-come established as a result of minor disturbances (including tree harvest) that cause progressive but partial mortality of overstory trees, thereby perpetuating a multi-layer, multi-cohort structure. This class consists of a broken overstory layer with a mix of sizes present (large trees are scarce); it provides high vertical and horizontal diversity (O'Hara et al. 1996).
OFMS – Old Forest Multi Stratum	3+	Many age classes and vegetation layers mark this structure class and it usually contains large old (150+ yrs) trees. Decaying fallen trees may also be present that leave a discontinuous overstory canopy. On cold or moist sites without frequent fires, multi-layer stands with large trees in the uppermost stratum may be present
OFSS – Old Forest Single Story	1+	Single-layer stand with large old trees in the uppermost stratum that evolved under the influence of frequent, recurring surface fires which regulates wide spread tree regeneration.

UI_Dist_Yr (Understory Initiation Disturbance and Year)

Source for this attribute: GI activity Layer; Historic fire layer.

Indicates year and type of disturbance that was of enough intensity to initiate natural regeneration.

DensityCla (Tree Density Class)

Source for this attribute: blues_evg.xlsx, plot data collected by Camp II and data verification process using 2012 NAIP aerial imagery.

Tree Density Class (expressed as basal area, in ft2/acre at 10″ QMD)

Density Class	Basal Area	
	Dry PVG	Moist PVG
Low	<45	<90
Moderate	45-70	90-135
High	>70	>135

Table of basal area ranges for QMD 8" to 24":

PVG/Tree Density Class	**SDI**	**BA Equivilant: ↘**	**Quadratic Mean Diameter (QMD)**								
			8	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**24**
Dry Low	<83	Less Than	41	45	49	52	55	57	60	62	64
Dry Moderate	83-128	Between	41-64	45-70	49-75	52-80	55-84	57-88	60-92	62-96	64-99
Dry High	>128	Greater Than	64	70	75	80	84	88	92	96	99
Moist Low	<165	Less Than	82	90	97	103	109	114	119	123	128
Moist Moderate	165-248	Between	82-123	90-135	97-146	103-155	109-163	114-171	119-178	123-185	128-192
Moist High	>248	Greater Than	123	135	146	155	163	171	178	185	192

Size_Cls (Tree Size Class)

Source for this attribute: blues_evg.xlsx, plot data collected by Camp II and data verification process using 2012 NAIP aerial imagery.

Tree size class code representing the upper size class meeting the minimum canopy cover threshold (10% for >20" and 20% for <20")

Size Class Codes (in inches)
<5
5-10
10-15
15-20
>20

S_ID

Original FID code for the stands within the commercial unit polygons. Used to calculate unit ID for commercial units (S_ID + 1 = Unit ID)

Unit_ID (Mechanical Treatment Unit Identifier)

Commercial Units = xxx; Pre-commercial units = xxxx

PA_Trt (Proposed Action Treatment Type)

Lower Joseph Proposed Action – Potential Treatment Types and Descriptions

Treatment Types	**Treatment Description**
Savanna	Reestablishment of grassland/forest edges and historic grasslands that have conifer encroachment.
Single Tree Selection (STS)	ICO variable density thinning within all age classes present
Group Selection (GS)	ICO variable density thinning within all age classes present; ½ to 4 acre group selection to initiate new cohort of seral species (PP/WL).
Intermediate Treatment (IT)	ICO variable density thinning within all age classes present with emphasis on isolating mistletoe infections and creating conditions that reduce intensification of infection.
Stand Improvement (SI)	ICO variable density thinning within young, post disturbance stands. SI_Pole indicates a high incidence of trees between 5 and 8.9" inches will be thinned; SI_SeedSap indicates the majority of trees needing thinned are <5".
Burn Only	Fire without mechanical. Assume low to mixed severity similar to moderate mechanical treatment intensity.

The STS, IT and GS treatment types have an intensity associated with them (Low, Moderate and High). The intensity code indicates a relative change in tree density as follows:

		Treatment Intensity:		
	Post Trt↘	High	Moderate	Low
Existing Density:	High	*Low*	*Moderate*	*High*
	Moderate		*Low*	*Moderate*
	Low			*Low*

The decision matrix used to determine treatment type and intensity to move project area toward RV:

				Density Class		
	PVG	**Composition Type**	**DMR Rating**	**Low**	**Mod**	**High**
Outside MA 15	Any	Persistent PIPO	None/Low	STS_Low	STS_Mod	STS_High
	Any	Persistent Shade Tolerant	None/Low	STS_Low	STS_Low	STS_Mod
	Dry	Any	Mod/High	IT_Low	IT_Mod	IT_High
	Dry	Recent PSME or Recent ABGR	None/Low	STS_Low	STS_Mod or GS_Mod	STS_High or GS_High
	Moist	Any	Mod/High	IT_Low	IT_Low	IT_Mod
	Moist	Recent PSME or Recent ABGR	None/Low	STS_Low	STS_Low or GS_Low	STS_Mod or GS_Mod
	Dry	Non-Conifer	None/Low	Savanna		
MA 15	Any	Persistent PIPO		STS_OG_Low	STS_OG_Low	STS_OG_Mod
	Any	Recent PSME or Recent ABGR		STS_OG_Low	STS_OG_Low	STS_OG_Mod
	Any	Persistent Shade		OG_NoTrt		

		Tolerant		

PAPTForCov (Proposed Action Post Treatment Forest Cover Type)

The following model was used to determine post treatment forest cover type:

Base Assumptions:

PVG	EC Cover	Composition Type	Treatment Intensity	Post Treatment Cover Type
Dry	PP	Persistent PP	All	PP
	PPmix			PPmix
	DF	Recent DF	Low	DF
			Mod or High	DFmix
	DFmix		Low	DFmix
			Mod or High	PPmix
	GF	Recent GF	Low	GF
			Mod or High	GFmix
	GFmix		Low	GFmix
			Mod or High	PPmix
Moist	PP	Persistent PP	All	PP
	PPmix			PPmix
	DF	Recent DF	Low	DF
			Mod or High	DFmix
	DFmix		Low or Mod	DFmix
			High	PPmix
	GF	Recent GF	Low	GF
			Mod or High	GFmix
	GFmix		Low or Mod	GFmix
			High	PPmix

Dry PVG Model

PVG	EC Cover	Composition Type	Treatment Intensity	Post Treatment Cover Type
Dry UF	PP	All	All	PP
	PPmix	All	All	PPmix
	DF	Persistent PP	Low	DFmix
			Mod or High	PPmix
		Recent DF	Low	DF
			Mod or High	DFmix
		Recent GF	All	DFmix
		Persistent ST	All	DFmix
	DFmix	Persistent PP	All	PPmix
		Recent DF	Low	DFmix
			Mod or High	PPmix
		Recent GF	Low	DFmix
			Mod or High	PPmix
		Persistent ST	Low	DFmix
			Mod or High	PPmix
	GF	Persistent PP	Low	GFmix
			Mod or High	PPmix
		Recent DF	All	DFmix
		Recent GF	Low	GF
			Mod or High	GFmix
		Persistent ST	Low	GF
			Mod or High	GFmix
	GFmix	Persistent PP	All	PPmix
		Recent DF	Low	DFmix
			Mod or High	PPmix
		Recent GF	Low	GFmix
			Mod or High	PPmix
		Persistent ST	Low	GFmix
			Mod or High	PPmix
	WL	Persistent PP	All	PPmix
		Recent DF	All	WL
		Recent GF		
		Persistent ST		
	WLmix	Persistent PP	All	PPmix
		Recent DF	All	WLmix
		Recent GF		
		Persistent ST		

Moist PVG Model

PVG	EC Cover	Composition Type	Treatment Intensity	Post Treatment Cover Type
Moist UF	PP	All	All	PP
	PPmix	All	All	PPmix
	DF	Persistent PP	Low	DFmix
			Mod or High	PPmix
		Recent DF	Low	DF
			Mod or High	DFmix
		Recent GF	All	DFmix
		Persistent ST	All	DFmix
	DFmix	Persistent PP	All	PPmix
		Recent DF	Low or Mod	DFmix
			High	PPmix
		Recent GF	Low or Mod	DFmix
			High	PPmix
		Persistent ST	All	DFmix
	GF	Persistent PP	Low	GFmix
			Mod or High	PPmix
		Recent DF	All	DFmix
		Recent GF	Low	GF
			Mod or High	GFmix
		Persistent ST	Low	GF
			Mod or High	GFmix
	GFmix	Persistent PP	All	PPmix
		Recent DF	Low or Mod	DFmix
			High	PPmix
		Recent GF	Low or Mod	GFmix
			High	PPmix
		Persistent ST	All	GFmix
	WL	Persistent PP	All	PPmix
		Recent DF	All	WL
		Recent GF		
		Persistent ST		
	WLmix	Persistent PP	All	PPmix
		Recent DF	All	WLmix
		Recent GF		
		Persistent ST		

PAPTStruct (Proposed Action Post Treatment Forest Structural Stage)

The following model was used to determine post treatment forest structural stage:

EC Structural Stage	Treatment and Intensity	Post Treatment Age Classes	Post Treatment Structural Stage	Assumptions
SI	No Treatment	1	SI	Likely shrub dominated
	Rx Burn	1+	SI	Assume shrub dominated and will remain so post Rx Burn where there are seedlings/saplings fire would be similar to ICO openings and will result in new cohort
	PCT (Low)	1	SI	Thin seedlings/saplings
SE	No Treatment	1	SE	Likely low density
	Rx Burn	2	UR	Assume fire would create openings and will result in a new cohort similar to ICO treatments
	PCT (Low)	1	SE	Thin seedlings/saplings and poles
	CT Low	1	SE	Thin existing age classes
	CT Mod	2	UR	Thin existing age classes; assume ICO created openings will result in new cohort
	CT High	2	UR	Thin existing age classes; assume ICO created openings will result in new cohort
UR	No Treatment	2	UR	Likely low density
	Rx Burn	3	YFMS	Assume fire would create openings and will result in a new cohort similar to ICO treatments. Assume fire only would not thin enough low diameter stems to kick the stand into OFMS.
	PCT (Low)	2	UR	Thin existing age classes
	CT Low	2	UR	Thin existing age classes
	CT Mod	3	OFMS	Size (not age) based…↑QMD kicks it into OF structure; assume enough large and old trees in overstory to meet definition; assume residual stocking in all age classes; assume ICO created openings will result in new cohort.
	CT High	1 or 2	OFSS	Size (not age) based…↑QMD kicks it into OF structure; assume enough large and old trees in overstory to meet definition; assume primary residual stocking will be in the overstory with incidental understory cohort.
YFMS	No Treatment	3	YFMS	Likely low density
	Rx Burn	3	YFMS	Assume fire would create openings and will result in a new cohort similar to ICO treatments. Assume fire only would not thin enough low diameter stems to kick the stand into OFMS.
	PCT (Low)	3	YFMS	Thin existing age classes
	CT Low	3	YFMS	Thin existing age classes
	CT Mod	3	OFMS	Size (not age) based…↑QMD kicks it into OF structure; assume enough large and old trees in overstory to meet definition; assume residual stocking in all age classes.
	CT High	1 or 2	OFSS	Size (not age) based…↑QMD kicks it into OF structure; assume enough large and old trees in overstory to meet definition; assume primary residual stocking will be in the overstory with incidental understory cohort.
OFMS	No Treatment	3	OFMS	Likely low density
	Rx Burn	2+	OFMS	Assume fire would create openings and will result in a new cohort similar to ICO treatments. Fire would also selectively target small diameter trees raising the canopy height
	PCT (Low)	3	OFMS	Thin existing understory age classes
	CT Low	3	OFMS	Remove competition from old tree overstory, thin large tree overstory and thin existing understory age classes; assume residual stocking in all age classes.
	CT Mod	3	OFMS	Remove competition from old tree overstory, thin large tree

				overstory and thin existing understory age classes; assume residual stocking in all age classes.
	CT High	1 or 2	OFSS	Remove competition from old tree overstory, thin large tree overstory and thin incidental under story clumps; assume primary residual stocking will be in the overstory with incidental understory cohort.
OFSS	No Treatment	1 or 2	OFSS	Likely low density
	Rx Burn	1 or 2	OFSS	Assume fire only would create openings and will result in a new cohort similar to ICO treatments.
	PCT (Low)	1 or 2	OFSS	Remove understory competition from Old/large tree overstory and thin incidental understory clumps.
	CT Low	1 or 2	OFSS	Remove competition from old tree overstory, thin large tree overstory and thin incidental understory clumps
	CT Mod	1 or 2	OFSS	Remove competition from old tree overstory, thin large tree overstory and thin incidental understory clumps
	CT High	1 or 2	OFSS	Remove competition from old tree overstory, thin large tree overstory and thin incidental understory clumps

PAPTDenCls (Proposed Action Post Treatment Tree Density Class)

The following model was used to determine post treatment tree density class:

		Treatment Intensity:		
	Post Trt↘	High	Moderate	Low
Existing Density:	High	*Low*	*Moderate*	*High*
	Moderate		*Low*	*Moderate*
	Low			*Low*

PAPTSzCls (Proposed Action Post Treatment Tree Size Class)

The following model was used to determine post treatment tree size class:

EC Size Class	Structural Stage	Treatment and Intensity	Post Treatment Size Class
<5		No Treatment	<5
		Rx Burn	5-10
		PCT (Low)	5-10
5-10		No Treatment	5-10
		Rx Burn	10-15
		PCT (Low)	5-10
		CT Low	5-10
		CT Mod	10-15
		CT High	10-15
10-15		No Treatment	10-15
		Rx Burn	15-20
		PCT (Low)	10-15
		CT Low	10-15
		CT Mod	15-20
		CT High	15-20
15-20		No Treatment	15-20
		Rx Burn (Low)	15-20
		PCT (Low)	15-20
		CT Low	15-20
		CT Mod	>20
		CT High	>20
>20		No Treatment	>20
		Rx Burn (Low)	>20
		PCT (Low)	>20
		CT Low	>20
		CT Mod	>20
		CT High	>20

Ecoclass_1

Plant association.

Source for this attribute: Camp II data.

Eclass_cor

Corrected plant association.

Source for this attribute: Corrected when Camp II data had incorrect code or did not match tree data.

PVT_Code

Potential vegetation type.

Source for this attribute: Camp II data.

PAG_1

Plant association group.

Source for this attribute: Camp II ecoclass code.

ExamDatRel (Exam Data Reliability)

An assessment of the reliability of the exam data that is included in this data base. Reliability is based on multiple factors including homogeneity of inventoried stand polygon, inventoried stand polygon reconfigured (broken up) due to treatment unit, improperly matched stand tags and incomplete data. Data marked as **poor** has one or more issues and would not be appropriate to use for other than a general assessment of PVT and species composition. For data marked as **OK**, it is appropriate to use for all data entries.

QMD (Quadratic Mean Diameter)

Calculated quadratic mean diameter based on the trees per acre by size class and the mid-point diameter of the size class.

BA_Calc (Basal Area Calculated)

Total basal area.

TPA_GT5

Trees per acre greater than 5”.

TPA_GT120_

Trees per acre greater than 120 years old and greater than 21”.

TPA_GT1201

Trees per acre greater than 120 years old and less than 21”.

TPALT120_

Trees per acre less than 120 years old and greater than 21”.

TPA_LT1201

Trees per acre less than 120 years old and less than 21”.

_TotB

Percent of total basal area. Calculated for each age class (age R, 1, 2, 3, 4 and 8)

_TPA_G

Tree per acre greater than 21”. Calculated for each age class with trees in size class 8, 9, 10 and 11.

_TPA_L

Tree per acre less than 21”. Calculated for each age class with trees in size class 5, 6 and 7.

RxFireNeed_Alt2 and **RxFireNeed_Alt3**

Prescribed fire priority rating based vegetation treatment and potential vegetation group. All areas where harvest and stand improvement rate as high. In addition to the treatment areas all dry upland forest are rated high for prescribed fire implementation. All moist upland forest outside vegetation treatment (harvest and stand improvement) is rated moderate. The remaining land is composed of non-forest vegetation types and rated as low priority.

All Other Tree Data Attributes for Exam Data Collected by Camp II Forest Management [Larry Nall]

All other attributes and codes for the data collected are documented in the document referenced below →

Appendix D - Lower Joseph Creek Watershed Assessment of Forest Conditions – EVG Data Entry Form Definitions

Appendix C – Landscape Modeling Methods (See FEIS)

- State-and-transition Modeling Overview
- Climate Informed Modeling
- Cumulative Effects of the Eastside Screen Plan Amendment on Large Trees

Appendix D – Burn probability modeling methods

The Blue Mountains Restoration Team analyzed wildland fire probability as a component of the landscape analysis for the LJCRP and surrounding lands (as a potential influence to disturbance probabilities outside the project boundary). The FSim platform was chosen since it offers the most robust modeling framework with rich inputs for weather, wind, and historic fires. The large-fire simulation system, FSim, consists of modules for weather, fire occurrence, fire growth, and fire suppression. The system is designed to simulate the occurrence and growth of fires for thousands of years in order to estimate average burn probabilities and fire size distributions. It was applied independently to 6-10 delineated areasof the landscape, called Fire Planning Units (FPUs,) in the Blue Mountains. Each model component, data inputs and outputs and FPU are described in the following sections.

Inputs:

Fire Planning Units (FPU's) – Due to the large size of the Blue Mountains landscape and the associated large and cumbersome database size, the landscape was too large for FSim to effectively run. Given this modeling limitation, the landscape was broken into areas used by the Blue Mountains Forests known as FPUs. The USFS's Fire Danger Rating Areas (FDRAs) were used as the starting geography point for analysis. The FDRAs were further reduced based on vegetation condition and Forest Boundaries. The intent was to create similar sized rectangular blocks with similar vegetation, management, and fire behavior influences such as weather, topography, and assumed fire regime.

Weather – The necessary weather files for each FPU were generated from Fire Family Plus based on expert opinion and Remote Automated Weather Station (RAWS) data. In some cases the multiple RAWS data were combined for an FPU. Local expert opinion was utilized to give a weighted percent to each RAWS station so that the Fire Family Plus weather input represented the most frequent trend for each FPU.

Historical Fire Occurrences Density - The historical fire data used in this analysis was based on the Historical national fire occurrences data that Karen Short compiled for the Continental US Analysis with Mark Finney.

Fuels and topography - Spatial information on fuels and topography was obtained at 30 m resolution from 2012 LANDFIRE in a Landscape file (.LCP) and then resampled to 90 m resolution to achieve practical simulation run times.

Outputs:

Each FPU was buffered 10 miles to allow for fires to burn onto the landscape and limit edge effect. The outputs from all the FPUs merged into a single landscape level output using a statistical overlay for the overlapping areas. The landscape outputs are described below.

- Burn Probability – A spatial layer with 0-100 % probability of a pixel burning in a given year.
- Fire Intensity Level, FIL (1- 6) – Six spatial layers with intensity by Flame Length categories. Each spatial FIL has a probability, the sum of all 6 equal the overall Burn Probability.
- Mean Fire Intensity – A spatial layer with the mean intensity values for each pixel